# A MODEL FOR COST OF RESIDENTIAL POWER OUTAGES: A SAUDI ARABIAN STUDY CASE

BY

**Talal Hasan Al-Malki**

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This thesis, written by Talal Hasan Al-Malki under the direction of his thesis advisor and approved by his thesis committee, has been presented to and accepted by the Dean of Graduate Studies, in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE IN ELECTRICAL ENGINEERING.

Thesis Committee

Dr. Ibrahim M. El Amin (Advisor)

Dr. Mohammad Ali Abido (Member)

M. Kassas

Dr. Mahmoud Kassas (Member)

Dr. S. H. Abdul-Jauwad

Department Chairman

Dr. Salam A. Zummo

Dean of Graduate Studies

عمادة الدراسات العليا

DEANSHIP OF GRADUATE STUDIES

29/1/11

Date

بسم الله الرحمن الرحيم

Dedicated to

My Parents, Wife

And

Teachers

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Praise and glory to Allah the most gracious and merciful, who gave me courage and patience to carry out this work. Peace and blessing of Allah be upon last Prophet Muhammad (Peace Be upon Him).

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# THESIS ABSTRACT


| | | |
|---|---|---|
| Name | : | Talal Hasan Dakheel Al-Malki |
| Title | : | A model for Cost of Residential Power Outages: A Saudi Arabian Study Case |
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Area of outage costs and customer willingness to pay studies have been increased due to the growing competitive electricity market and increasing for demand.

This thesis presents the methodology and main results for Saudi Arabia residential customers survey. The survey provided the cost estimates that have been incorporated in the quality of supply in terms of the cost of un-server kWh not supplied and damage costs. Customer willing to pay (WTP) has been evaluated for residential customer as well. As a part of this thesis, key performance indicators (KPI) have been calculated and compared to measured KPI in year 2007 for Saudi Arabia.



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# ملخص الرسالة

**الاسم : طلال حسن دخيل المالكي**

**عنوان الرسالة : دراسة تكلفة انقطاع التيار الكهربائي للمناطق السكنية في المملكة العربية السعودية**

**التخصص : هندسة كهربائية**

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**الدرجة : ماجستير في الهندسة الكهربائية**

نظرا لتطور و نمو سوق الكهرباء التنافسية والطلب المتزايد لطاقة الكهربائية, اهتمت العديد من الدراسات بتكلفة الانقطاعات الكهربائية على كل من المستهلكين أو الجهات المزودة للخدمة.

تعرض هذه الرسالة الطرق والنتائج الرئيسية للاستبيان المعمول لمشتركي شركة الكهرباء في المناطق السكنية لدراسة جودة الخدمة المقدمة. قدمت الدراسة تقديرات التكاليف الناتجة لانقطاع التيار الكهربائي من حيث قيمة الطاقة التي لم تستخدم و قيمة الأضرار الناتجة في الأجهزة أو غيرها. كما تضمنت الدراسة سؤال المشاركين في الاستبيان فيما إذا كانوا يؤيدون أن يدفعوا مبالغ إضافية للحيلولة دون انقطاع الخدمة عنهم.

# CHAPTER 1

# INTRODUCTION

## 1.1 Overview

Electrical power is the most important material used by residential, commercial and industry today. Continuous flow is required and it cannot be subject to quality assurance checks before it is used. Power supply reliability must be known and the resilience of the process to variations should be understood. In reality, electricity is special product and differ from any other product. It is generated far away from the location of use, fed to the electrical grid together with the output of many other generators and transmitted to the point of use through several transformers and very long overhead and possibly underground cabling. Assuring the power quality of the delivered electricity at the point of use is not easy job and it is not possible that sub-standard electricity can be withdrawn from the supply chain or rejected by the customers.

From the consumers' point of view, the problem is more complex. There are few and limited statistics obtainable on the quality of the delivered power. The acceptable power quality level as received by the supplier and the industry regulator may be different from that desired or required by the consumer. The most noticeable power defects are power interruption which may take from a few seconds to several hours and voltage dips or sags when the voltage drops to a worse value for few cycles of the frequency or a few seconds. Of course, long power interruptions are a problem for all Customers and many operations are quite sensitive to even very short interruptions. Examples of sensitive process are:

- **Continuous process operations**: when short interruptions can interrupt the synchronization and harmonization of the equipments which result in large volumes of damaged or low quality product. For example, the paper making industry where the operation of clean-up the product is long and expensive.
- **Multi-stage batch operations**: If an interruption occurs during one process  it will destroy the value of previous process. simple example of this operation is the semiconductor industry where manufacturing of a wafer requires a many processes over several days. if a failure happened in a single process it will be terrible.
- **Data processing**: this happens when the transaction value is high and the processing cost of is low and any failure to traffic can cause large losses which may exceed the cost of the operation. An example of this type is share and foreign exchange dealing.

So, what is meant by ‘power quality’? An ideal power supply would be one that is always available within voltage and frequency tolerances and has a sinusoidal wave shape. Setting the accurate tolerated depends on the customer application, type of equipment installed and his requirements. Power quality will be interrupted if on of the following defects occur: blackouts, harmonic distortion, dips (or sags) and surges, under or over voltage, and transients. Every one of these power quality problems has a different cause. Some problems are an outcome of the shared infrastructure or a problem at one customer’s site which may generate a transient that affects other customers connected to the same subsystem. Problem such as harmonics, arise within the customers own installation and may or may not propagate onto the network. Harmonic problems can be overcome by a combination of proper design and well proven reduction equipments.

There is a wide range of engineering solutions available to eradicate or minimize the effects of supply quality problems and it is very active area of innovation, development, and improvement.

## 1.2 Power Quality

Power quality Term defined in IEEE Standard Dictionary of Electrical and Electronics as "the concept of powering and grounding sensitive electronic equipment in a manner that is suitable to the operation of that equipment." Power quality may also be defined as "the measure, analysis, and improvement of bus voltage, usually a load bus voltage, to maintain that voltage to be a sinusoid at rated voltage and frequency." [1, 2]

Loads are susceptible to momentary interruptions, harmonics, transients, sags, swells and other disturbances that were not cause for concern in the past. For sensitive loads, the electric service quality has grow to be as important as its reliability. Events such as harmonics, voltage sags, impulses, and phase imbalance are now power quality issues. Power quality problems have a large economic impact and any research of power system reliability must also include power quality[3].

power quality can be measured through different indices. The most common indices are the following [1]-[4]:

- Total harmonic distortion (THD): The ratio of the root mean square (RMS) value of the sum of the individual harmonic amplitudes to the RMS value of the fundamental frequency
- K factor: The sum of the squares of the products of the individual harmonic currents and their harmonic orders divided by the sum of the squares of the individual harmonic currents
- Crest factor: The ratio of a waveforms peak or crest to its RMS voltage or current
- Flicker: A perceptible change in electric light source intensity due to a fluctuation of input voltage. On other word, is the change in voltage divided by the average voltage expressed as a percent? This ratio is plotted vs. the number of changes per minute to develop a "flicker curve."

### 1.3 Reliability

Reliability can be defined as “the degree of performance of the elements of the bulk electric system that results in electricity being delivered to customers within accepted standards and in the amount desired” [7]. Reliability can be measured by the frequency, duration, and magnitude of undesirable effects on the electric supply. Electric system reliability can be demonstrated by considering two basic functional aspects of the electric system which are Adequacy and Security [5,6]. On the other hand, reliability cost is defined to be the investment needed in the system to reach a certain reliability level. The reliability worth is defined to be the financial benefit derived by the supplier and customer of such an investment [7].

Availability of a reliable power supply is one of the foundations of any nation's economic growth. In general, electric utilities attempt to meet customer demands as economically as possible and at a realistic and reasonable level of supply reliability [8]. Also, there is no obligation for the utilities in choosing reliability levels in power system planning and operation. It is depending on the probabilistic criteria and work experiences. Moreover, The prices of electricity power normally vary in accordance with the utility’s reliability standards level [9].

In brief, reliability deal with total electric interruptions and complete loss of voltage and not limited to the deformations of the electric sine wave. Reliability does not cover harmonics, impulses, sags or swells,. Reliability indices mainly considering below aspects:

- Number of customers.
- Connected load.
- Duration of the interruption measured in seconds, minutes, hours, or days.
- Amount of power (KVA) interrupted.
- Frequency of interruptions.

### 1.4 Interruption Cost and Measuring Techniques

An interruption takes place when consumers are supplied with less electric energy from the power system than originally planned [10]-[12]. The shortage can be

- Capacity shortages which related to situations where the available capacity is lower than peak load. This may result from generation or network failures.
- An energy shortage which occurs when the amount of electricity that would have been purchased during given period exceeds the energy available during that period.

There are many measuring techniques to estimate interruption costs. The common techniques are demonstrated on figure 1.1 as follow [10]-[14]:

- **Indirect - Proxies**: indirect data used to derive information on interruption costs. For example, the ratio of Gross National Product (GNP) to the electricity consumed which forms roughly the upper bound for the interruption costs
- **Indirect - Consumer Surplus Methods**: interruption costs information will be driven from electricity demand curves.
- **Indirect - Costs of Backup Power:** Consumers may take preparatory actions like installing backup power in order to prevent the costs that come up from interruptions. The marginal investment cost of generating its own power may then serve as an estimate for the marginal interruption costs.
- **Ex post Surveys - Blackout Studies** : This method is usually used in large scale interruptions where information will be collected from the customers directly about interruption costs from actual interruptions.
- **Ex ante Surveys - Direct Costs**: This is similar to above method where interruption costs will be requested directly from consumers. This is used for studying an economic value to each cost category. Interruption costs will be obtained by summing up all the individual costs for industrial and commercial consumers like loss of sales or production, spoilage, damage, … etc.
- **Ex ante Surveys – Econometric**: Econometric methods can be classified into two main categories:
    - Under the contingency ranking method where consumers are asked to evaluate the reliability as if there were a market for it.

- Conjoint analysis which is similar to contingency valuation with the difference that the willing to accept WTA and willing to pay WTP figures are derived indirectly.

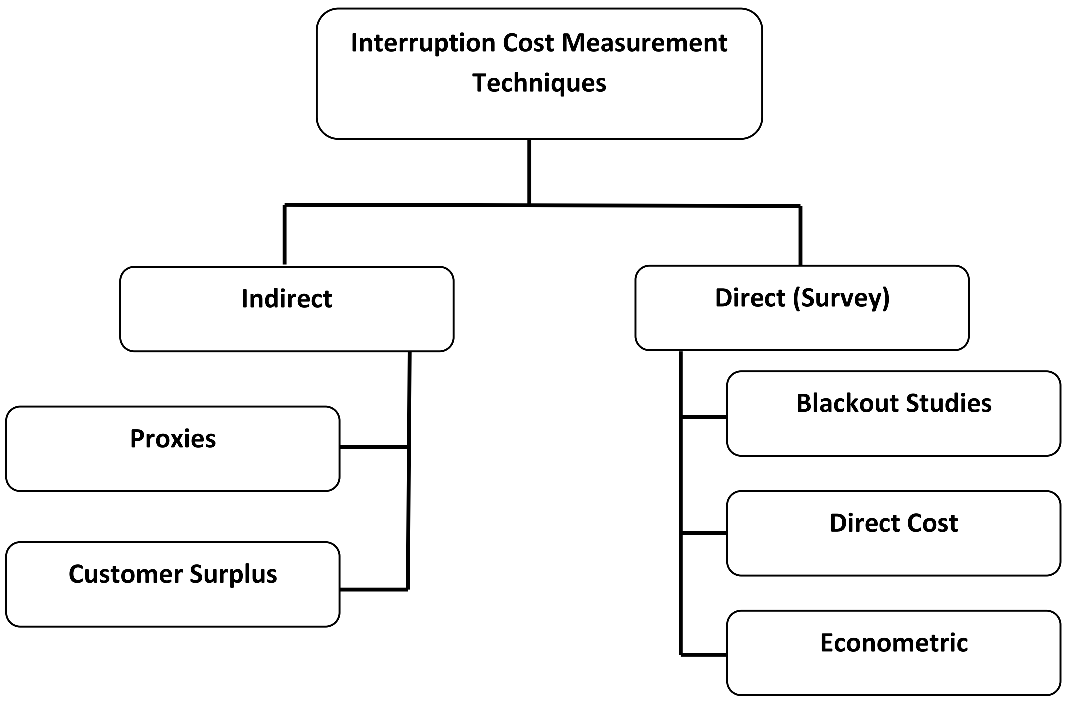


Figure 1.1: Overview of interruption cost measurement techniques.

The interruption costs are driven by a number of factors:

- **Duration** : Interruption duration and cost have proportional relation. As an interruption takes long time to eliminated, interruption costs increase.
- **Perceived Reliability Level**: Reliability level at which the consumer is being supplied is another factor that influences the level of interruption costs. Usually, the higher the reliability level, the more stable and severe from an interruption impact.
- **Timing**: Interruption costs vary with the time of the year - summer or winter - and day of the week – working days or weekend - and time of the day.
- **Advance Notice**: For Planned interruption, e.g. in case of energy shortages or maintenance activities, advanced notice may be provided to consumers about the occurrence or duration of the interruption.
- **Consumer Dependency**: The degree of consumer dependence on a reliable electricity supply also influences the level of interruption costs.

Residential sector costs are more difficult to estimate since they are likely to be dominated by subjective and less tangible effects such as inconvenience, fear, etc. The opinions and expectation at the time of a survey are therefore important aspects of the process of evaluating customer outage costs [14, 15].

## 1.5 Thesis Motivations

In recent years, survey-based methods of eliciting outage costs have come to dominate the literature. The survey approach is attractive, in that, it yields the distribution of outage costs across customers and across a wide variety of hypothetical outage conditions.

Although, survey-based estimates have yielded widely disparate results to date, even within the same customer sector, surveys provide information based only on customers' attitudes and intentions, it is considered one of the flexible and recommended methods.

However, given the growing importance of outage cost information, it is desirable that the survey-based results be validated using estimates derived from actual market behavior. This approach has received little attention to date due to the general lack of suitable data. So, cost estimation using information on customer participation for the past interruptions is so important.

Electricity consumption in the Saudi Arabia has grown substantially over the last years. most of the electricity is consumed by residential and industrial customers. The sold energy has witnessed a growth of 6.8% at year-end 2009, bringing up the total sold energy in 2009 to 193,472 GWH, compared with 181,098 GWH in 2008. The percentage distribution rates of the sold energy on year 2009 for the residential, commercial, and industrial are 52.11%, 12.20%, and 17.91% respectively as shown in figure 1.2. Residential customers reported for year 2009 was 4,675,554 customer which represents 82% of the total customer served by Saudi Electricity Company as illustrated in figure 1.3. [16]

So, with the growing of residential consumption, it is important to look at the service quality and its impact on consumer.

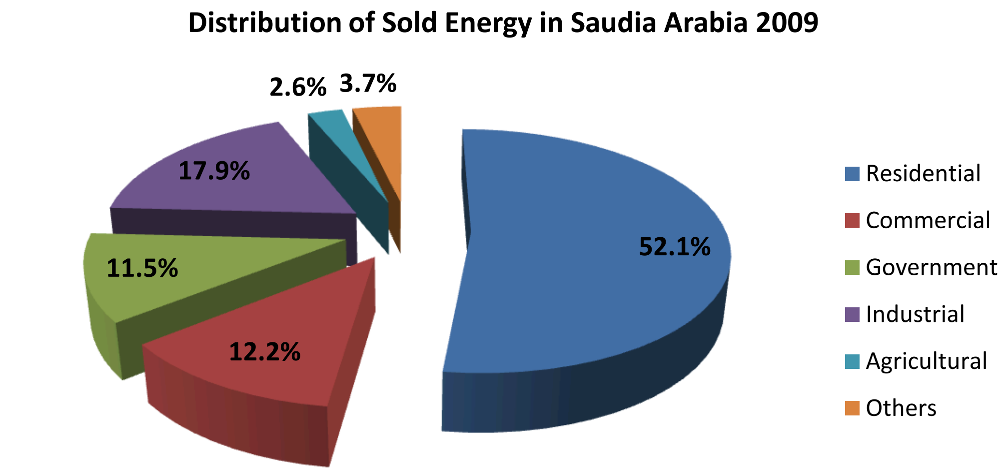


Figure 1.2: Distribution of sold energy in Saudi Arabia for year 2009

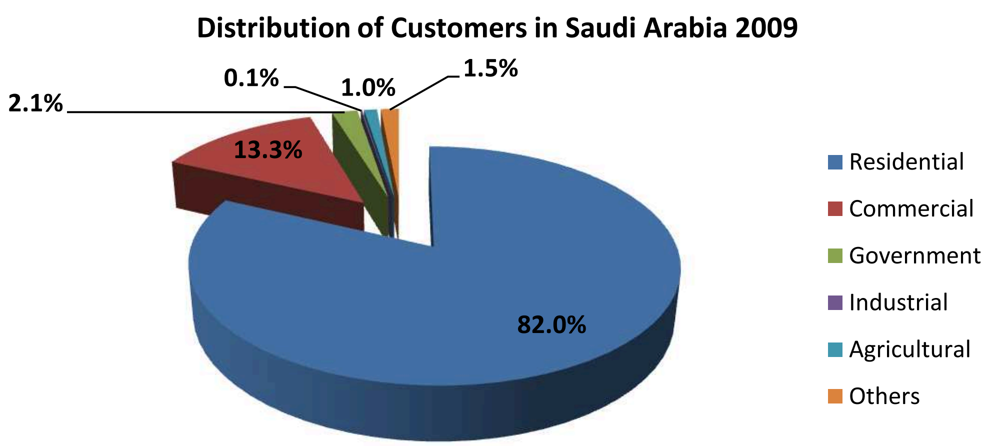


Figure 1.3: Distribution of customers in Saudi Arabia for year 2009

## 1.6 Thesis Objectives

The specific objectives of this work are as follows:

- Conduct a survey of residential power outages for Saudi Arabian customers.
- To develop an econometric model for power outage cost. This study will cover the cost of kwh un-served and the cost of interruption damages which include appliances damages as well as food damages. Also, study will measure residential customer willingness to pay extra charges in order to receive more reliable power supply.
- Application of the model of power outage: case study will be based on customer survey for residential customers.

## 1.7 Thesis Organization

Chapter 1 is the introduction to this thesis, and provides a summary of the background of this thesis. The task description and the thesis organization are also provided.

Chapter 2 presents the literature survey.

Chapter 3 provides an overview of the  proposed methodology and formulation.

chapter 4. presents the case study for the residential power outages, willing to pay, kWh un-served, damage costs and KPI have been calculated.

Chapter 5 presents the case study for the industrial power outages.

Chapter 6 presents the conclusion and future work

# CHAPTER 2

## LITERATURE SURVEY

### 2.1 Overview of Literature

Several studies have been carried out in developed countries like Finland, Sweden, UK, USA, Canada in order to evaluate the impact of power supply outage on the customer and also to analyze and estimate the cost of outages [9]. There are different assessment approaches either by direct or indirect techniques. Investment in new distribution networks and improving the reliability of the existing networks has always been in a challenge in developing economies. proper maintenance practices cannot be implemented unless the costs of the electrical interruptions are fully appreciated by the utility and customers. Reliability can be classified into two categories [17]:

- **System security:** refers to the capability of the network to respond satisfactorily to network disturbances like transmission line outage or generator outage.
- **System adequacy:** refers to the system capability to meet the load requirements for both generation and network capacity.

This will establish a balance between the investment cost of improving service reliability and quality and the economic benefits. This is called Value Based Reliability Planning **(VBRP)**.

Network investment can be approached through two main methods:

- **Deterministic methods**: network investments are done in advance because nothing is left to chance. So, probabilities are not taken into account.
- **Reliability methods:** probabilities are applied to ensuring the best investment decisions.

*C*. Mushwana and D. Pillay present in [17] the investment criteria to be:

**Least Economic Cost Criteria**: The investment cost from electricity utility to provide better quality of power supply like power lines, power transformers and new substations should be less than the cost of improved quality of supply to customers.

**Cost Reduction Investments**: the required investment will results in a cost reduction in the utility's operational costs like refurbishment of entire substations, substation equipment, power lines or installation of equipment that result in reduction in network losses like shunt capacitors.

**Statutory or Strategic Investments**: meeting requirements for legislation and safety as well as a response to government requests. Example: Construction of oil containment dams and servitude acquisition.

Supplying an acceptable quality with reasonable cost should be balanced between the value of quality which can be measured in terms of interruption cost and voltage disturbances. Different methodologies have been used to evaluate this cost [13, 18]:

- **Indirect analytical methods**: to estimate reliability of supply either by the electrical tariff or by taking the ratio of the Annual Gross Product to the total electricity consumption.
- **Case studies of blackouts**: to assess costs after major blackouts and estimate both direct and indirect impact of a specific interruption.
- **Customer surveys**: Questionnaire will be used to communicate with customers in order to collect their feedback about the losses cost due to used to interruptions. This method will estimate the cost for different interruption conditions like duration of the interruption and time of occurrence. The disadvantage of this method is that it is costly and required hard efforts to get customer responses compared to other approaches. Even though, customer survey approach is used widely to estimate the customer interruption cost.

The main data that can be collected from a survey is:

- Costs of long interruptions ( $\geq$3 min)
- Costs of short interruptions (< 3 min)
- Costs related to voltage disturbances
- Costs related to partial interruptions or load shedding
- Customers perception of quality of supply.

- Consumer flexibility regarding price versus quality of supply.
- Customer type (Industrial, Commercial, Agricultural, Residential).
- Energy requirements
- Interruption characteristics such as duration, frequency, time of occurrence, advance warning, etc.
- Voltage dips.

Gerd H. Kjølle, Knut Samdal, Balbir Singh and Olav A. Kvitastein conducted a survey for Norwegian customers to obtained the values in NOK per voltage dip or interruption [18]. The parameters used in this study are normalized energy not supplied (ENS)in kWh for long and interrupted power on kW for dips and short interruption. With reference to time, ENS for an interruption is estimated using the following approximation:

$$ENS = \int_{T1}^{T2} P(t) \approx \sum_{h=i}^{h=i+n} P_h \quad [kWh] \qquad (2.1)$$

Where:

$$ENS\ is\ the\ estimated\ energy\ should\ have\ been\ supplied\ if$$
$$the\ interruption\ did\ not\ occur$$
$$P_h\ is\ the\ average\ load\ at\ any\ hour\ h\ [\frac{kwh}{h}]$$

Table 2.1 shows the questionnaire used in above survey which focus on information about the respondent, interruption cost and time, action taken to minimize the losses and the customer flexibility.

TABLE 2.1: Content of Questionnaires for Norwegian Customer Survey were Values in NOK per Voltage Dip or Interruption [18]

| | |
|---|---|
| I | **INFORMATION ABOUT THE RESPONDENT AND ELECTRICITY CONSUMPTION** |
| | SIC business sector, business size, working hours, type of offices, other energy sources, etc. Yearly electricity consumption in kWh and NOK |
| | Electricity usage. Perceived Qos (interruptions, voltage disturbances and information/notification) |
| II | **COST OF INTERRUPTIONS AND VOLTAGE DIPS** |
| | Total cost in NOK for different durations of incidents occurring at reference time: 50% dip in 1 sec., interruption of 1 min., 1 hour, 4 hours, 24 hours |
| | Cost divided in A) Damage of equipment, spoiled goods or raw material etc., B) Loss of production, C) Extra costs for lost hours of work, D) Starting costs, E) Other costs. |
| | Portion of costs related to space and water heating, cooling and freezing, production processes, electric boilers, data processing etc. |
| | Modification of costs in case of advance warning, necessary warning time |
| III | **CHANGES IN COSTS FROM REFERENCE TIME** |
| | By season (months), time of week (weekdays), time of day |
| IV | **COST REDUCING ACTIONS** |
| | Type of actions: reserve supply, UPS, protection, insurance etc. |
| | Cost of action and valuation of reserve supply possibilities (WTP) |
| V | **CONSUMER FLEXIBILITY** |
| | Willingness to accept compensation in case of load shedding |
| | Willingness to pay reserve supply for parts of the electricity demand |

Some studies illustrate the development of approximate methods to estimate customer interruption. Costs related to specific outage events are calculated and compare the results obtained from different methods. R. Billinton and W. Wangdee classify the required data as [19]:

1) **Customer data**: find out the customers connected to each load point on the feeder taking in consideration customer type and the load demand for each customer.
2) **Load data**: Electrical utility does not know the load profile of each customer exactly since most metering devices are energy based. So, the individual customer profile will follow the representative sector load profiles as an estimation. Sector load profile can be created for any time in the year.
3) **Cost data**: Customer interruption cost will be function of frequency, time, season and nature of customer activities. Each of these elements will have an impact on the customer cost weight factor.

Three techniques have been modified and compared to base method done by R. Billinton as shown in table 2.2 which are [19]:

- The expected customer outage cost ECOST is calculated at each individual load point to get the feeder ECOST.
- Sector-by-Sector Approach
- Annual Energy Approach

Table 2.2 shows the required data and system used to obtain the interruption cost form above estimated methods.

TABLE 2.2: A Comparison of Customer Interruption Cost Evaluation Approaches[19]

| Data and System Requirement | Base Method | Demand Approach | EUE Approach | Annual Energy Approach* |
|---|---|---|---|---|
| 1. Computer program required | $Y^1$ | $Y^1$ | $Y^2$ | - |
| 2. Customer data | | | | |
| - SIC designation of individual customer | Y | - | - | - |
| - Average load of individual customer | Y | - | - | - |
| - SIC designation of major customers in each sector | Y | - | - | - |
| - Average load of customer sector (% ann. Energy) | Y | Y | Y | Y |
| 3. Load data | | | | |
| - Annual load profile of individual customer (L.F. of individual customer is known) | Y | - | - | - |
| - Annual load profile of customer sector (L.F. of customer sector is known) | (Y) | Y | Y | - |
| 4. Cost data (from survey) | | | | |
| - ICDF of each SIC designation | Y | - | - | - |
| - SCDF of each customer sector | - | Y | Y | Y |
| - Time varying cost weight factor | Y | Y | Y | Y |
| Ranking of the accuracy of the evaluation | 1 | 2 | 3 | 4 |

NOTE:
Y= yes, it is necessary
(Y)= yes, these data set are used when individual customer data set are not available.
$Y^1$= yes, using a complex procedure.
$Y^2$= yes, using a simplified procedure.
- = no, it is not necessary.
* = assume EENS is known, and could involve reallocation of energy consumption during night time (10pm-6am)

A methodology for area annual outage cost (AAOC) assessment by probabilistic reliability evaluation is presented [20]. The Interrupted Energy Assessment Rate (IEAR) have been estimated using macro approach which uses relations between the Gross Regional Domestic Product (GRDP) and the area electrical energy demand EED.

$$AAOC_k = IEAR_k \times EENS_k \quad [\text{M\$}] \tag{2.2}$$

$$IEAR_k = GRDP_k \times EED_k \quad [\frac{\$}{kWh}] \tag{2.3}$$

EENS = expected energy not supplied
IEAR = interruption energy assessment rate

L. Goel and R. Gupta include the customer interruption cost in a reliability well-being assessment for sub-transmission systems [21]. Reliability worth indices have been calculated and to evaluate the results for both expected cost of interruption (ECOST) and interrupted energy assessment rates (IEAR).

The basic formulas used by L. Goel and R. Gupta to estimate IEAR are:

$$EENS = \sum_{i=1}^{N} m_i f_i d_i \quad (\frac{kWh}{period}) \tag{2.4}$$

$$ECOST = \sum_{i=1}^{N} c_i (d_i) f_i m_i \quad (\frac{\$}{period}) \tag{2.5}$$

$$IEAR = \frac{ECOST}{EENS} \quad (\frac{\$}{kWh}) \tag{2.6}$$

Where:
$m_i$ =load curtailed (kW) due to capacity shortfall
$f_i$ = frequency of outage event i
$d_i$ = duration of outage event i
$c_i(d_i)$ = cost in \$/kW of outage duration $d_i$ using the cost function SCDF or CCDF
EENS = expected un-served energy due to all possible load curtailment events
ECOST = expected interruption costs due to all possible load curtailment outage events, and
N= the total number of load loss events.

Also another survey has been carried in Finland where there are 94 electrical distribution companies [22]. Power quality (PQ) included in calculation of interruption cost since it is affects company net revenue. Lassila, Honkapuro and Partanen present outage cost modeling as per tables 2.3 -2.4 [22].

TABLE 2.3: Outage Cost Methods and Customer Group Information [22]

| Outage cost method | Directing effects to network operation and planning |
|---|---|
| **Nationwide/Company-specific**<br>- No energy-weighting | All customers are equal in sense of outage costs. Consumption and customer group are neglected. (E.g. hospital vs. household)<br>⇨ No reasonable signal for network planning |
| **Nationwide/Company-specific**<br>- Energy-weighting | Priority in big customers. Customer group is still neglected. (E.g. small industry vs. farm)<br>⇨ Big customers are in priority e.g. in fault clearance |
| **Distribution substation-specific**<br>- Energy-weighting<br>- Customer group-specific | Consumption and customer group are noticed.<br>⇨ Investments and network operating focus economically right places |

TABLE 2.4: Network Investments and Operations and Their Impact on PQ [22]

| ++ = Strong Impact, + = Medium Impact, - = Slight or no Impact | | | |
|---|---|---|---|
| | Impact on PQ Long interruptions | | Short interruptions |
| | Number | Duration | |
| **Topology** (structure) of the network | | | |
| - new primary substations | ++ | + | + |
| - new medium voltage lines | + | + | + |
| ⇨ to short [line length / switch] | | | |
| - reserve lines (meshed networks) | + | ++ | - |
| **Components criteria** | | | |
| - underground vs. overhead lines | ++ | - | ++ |
| - coated cables vs. overhead lines | ++ | - | ++ |
| - surge arresters | - | - | ++ |
| - earth fault current compensation | + | - | ++ |
| - forestry work on line paths | + | - | ++ |
| **Network automation** | | | |
| - remote-controlled disconnectors | - | ++ | - |
| - fault location system | - | ++ | - |
| ⇨ aiming forestry work | - | - | + |
| - relay settings | + | + | + |
| **Organization training** | | | |
| - readiness for wide interruptions | + | ++ | + |
| network building and maintenance under operation (voltage work) | ++ | ++ | - |

Throughout the literature, the willingness to pay (WTP) to avoid unannounced interruptions in electricity service has been studied through direct surveys. Willing to pay study have been conducted for Swedish households by Fredrik and Peter [23]. Also, David F. Layton and Klaus Moeltner from US conduct a survey to study WTP and cost of power outages for heterogeneous households [24]. Generated model will follow a probability density function (pdf) for individual WTP. The assumption based on that the WTP are independently distributed across households and outages as gamma.

$$f\left(WTP_{ij}\right)=\frac{\left(WTP_{ij}/b_{ij}\right)^{c-1}\left[\exp\left(-WTP_{ij}/b_{ij}\right)\right]}{b_{ij}\,\Gamma(c)} \qquad (2.7)$$

$0 \leq$ WTPij $<\infty$

bij, c >0,

$\Gamma$(c) is the gamma function evaluated at c

Various studies have been conducted to measure customer interruption costs and willingness to pay for residential, commercial and industrial customers by Kristina Hamachi LaCommare and Joseph H. Eto for the power interruption in United states [25]. Garry Wacker and Roy Billinton discuss the estimated techniques proposed through the literature to calculate the interruption cost and their applications [26]. Stefano Quaia and FabioTosato concentrated on the interruption cost in the industrial plants caused by voltage dips [27-28]. Survey method have been used on [29] to study the implementation of such method to obtain supply outage cost. Also, in [30] large industrial customer data was used to estimate the interruption cost and the inexpensive outage cost for individual costumer. Some studies are just to report some findings and information about the average electrical environment at utility customer premises [31].

## 2.2 Reliability Indices

Customer-based indicators use information on the number of interrupted customers and the duration of the interruption. This will measure the reliability from the customer perspective. Bu having common and popular indices, it will be easy to interpret measures of reliability performance among different electrical utilities. On the other hand, lack of adequate information regarding the hourly use profiles of consumers leads to un-effective load management which cannot be used to control the loads by the utility [32].

There are many indices for measuring reliability. The three most common are referred to as SAIFI, SAIDI, and CAIDI [12,24,33].

**SAIFI**: system average interruption frequency index, is the average frequency of sustained interruptions per customer over a predefined area. It is the total number of customer interruptions divided by the total number of customers served.

$$SAIFI = \frac{Total\ Number\ of\ Customer\ Interruptions}{Total\ Number\ of\ Customer\ served} \qquad (2.8)$$

**SAIDI**: system average interruption duration index, is referred to as customer interruption duration and is used to calculate the average time the customers are interrupted. It is the sum of the restoration time for each interruption event times the number of interrupted customers for each interruption event divided by the total number of customers.

$$SAIDI = \frac{Total\ Customers\ Interruption\ Durations}{Total\ Number\ of\ Customer\ served} \qquad (2.9)$$

**CAIDI**: customer average interruption duration index, is the average time needed to restore service to the average customer per sustained interruption. It is the sum of all customer interruption durations divided by the total number of customer interruptions.

$$CAIDI = \frac{Total\ Customers\ Interruption\ Durations}{Total\ Number\ of\ Customer\ Interruptions} \qquad (2.10)$$

A reliability index that considers momentary interruptions is MAIFI

**MAIFI**: momentary average interruption frequency index, is the total number of customer momentary interruptions divided by the total number of customers served.

$$MAIFI = \frac{Total\ Number\ of\ Customer\ Momentary\ Interruptions}{Total\ Number\ of\ Customer\ served} \qquad (2.11)$$

**ASAI**: average system availability index, is the customer-weighted availability of the system and provides the same information as SAIDI. This index represents the fraction of time that a customer has power during either one year or the defined reporting period. Higher ASAI values reflect higher levels of reliability.

$$ASAI = \frac{Customer\ Hours\ Service\ Availability}{Customer\ Hours\ Service\ Demand} \qquad (2.12)$$

**CAIFI:** customer Average Interruption Frequency Index, is a hybrid of SAIFI and is calculated in the same way, with the exception that the normalization is based only on customers who have actually experienced an interruption.

$$CAIFI = \frac{Total\ Number\ of\ Customer\ Interruptions}{Customers\ Experiencing\ 1\ or\ more\ interruptios} \qquad (2.13)$$

**CTAIDI**: customer total average interruption duration index, is a hybrid of CAIDI, and is calculated in the same way with the exception that the normalization is based only on customers who have actually experienced an interruption.

$$CTAIDI = \frac{Customer\ Interruption\ Durations}{Customers\ Experiencing\ 1\ or\ more\ interruptios} \qquad (2.14)$$

## 2.3 Load-based and Energy-based Indicators

Customer-based indicators treat all customers equally and do not differentiate between the customers in terms of size, demand, energy consumption, extent of interruption damage.

Load and energy-based indicators will capture the heterogeneity between the customers. Here, interruptions are weighted depending on interrupted load which may clearly consider that size of connected capacity will impact proportionally the cost. This will reflect the clearer picture for the interruption impact. Following are the most common indices for load-base and energy base indices:

**ASIFI**: average system interruption frequency index corresponds to SAIFI but instead of the number of interrupted customers, it makes use of the amount of capacity disconnected during the interruption. This disconnected capacity is then normalized by the total served capacity by the network.

**ASIDI:** average system interruption duration index correspond to SAIDI but similarly to ASIFI, it uses connected capacity instead of customer numbers for the purpose of weighting and normalization.

Energy-based indicators are closely relevant to load-based ones. These characterize the amount of energy not supplied because of interruptions which is normalized by the number of connected customers.

## 2.4 Minimum Standards

Minimum standard can be different from one utility to another based on how they incorporate the measurement in the stander. This stander will become the medium level to perform certain aspects. In general, standards relate to performance at the aggregate level and could be measured using indicators such as SAIFI and SAIDI. Standers will be measured at the system level and will not propagate any quality deviation from customer to another. Practically, standers are applied at less aggregated level and if it is failed to be met, a penalty may be applied in form of price reduction or rebate for all consumers. [4,33]

One of the restrictions and disadvantages of the minimum standard that it imposes a discrete relation between performance and price. Minimum standard can be used to improve the quality level of the supply but at the same time some utilities will decide to perform at the minimum level in order to save cost. So, utilities should be smart when they apply the standers in order to keep their customer satisfied without breaking the trust by supplying low power quality.

## 2.5 Quality Incentive Schemes

A quality incentive scheme is similar to the minimum standard. A continuous relation is imposed between price and quality. For example, if the utility performs below the target quality, the incentive is a financial penalty but if it exceeds the target, the incentive comes in the form of a financial reward [33].

There are different quality incentive schemes illustrated in figure 2.1 such as

- Minimum Standard: if quality level reaches a defined level, a fixed penalty should be applied.
- Continuous scheme: applying penalty or reward based on the relation between price and power quality supplied. This will monitor the gap between actual and target performance.
- Capped scheme: similar to Continuous scheme but now with a cap on the level of penalty and reward.
- Dead Band: utility will set marginal tolerance quality from the stranded level where no price adjustments will be applied if the supplied power quality falls within this margin.

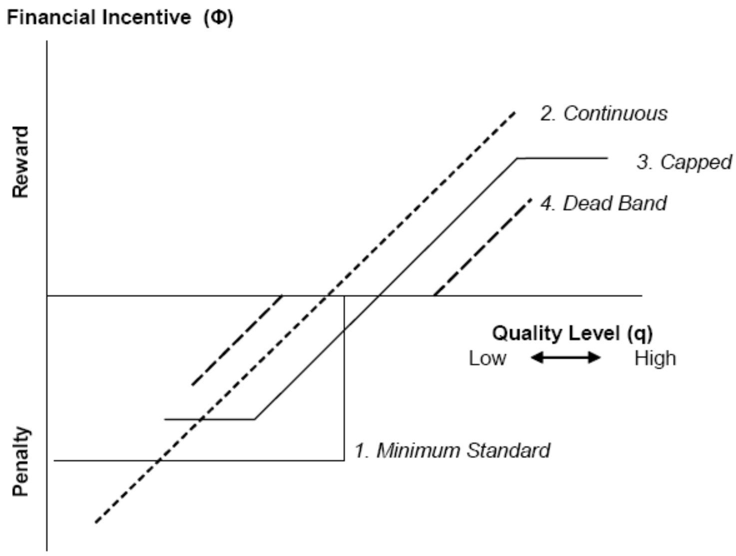


Figure 2.1: Examples of quality incentive schemes [33].

## 2.6 Optimal Quality

Interruption cost is the cost that consumer pay because of reliability being less than required. These costs can be divided into two main categories.

- Short-term interruption costs: these are the cost results from power unplanned shortage or blackout.
- Long-term adaptive response costs: these cost result from changing in customer capital by investing to install emergency equipment, backup generators, protective switchgear or uninterruptible power supplies.

On concept, optimum quality, and optimum incentive scheme can be designed to help the utilities to perform in practical way. On the other hand, by maintaining higher network reliability and supplying power with optimum quality, this will reduces interruption costs for consumers but also comes at higher costs. Sum of interruption cost and network costs at certain level will be lowest and this can defend the optimum quality level aimed as illustrated on figure 2.2. [16,19,33]

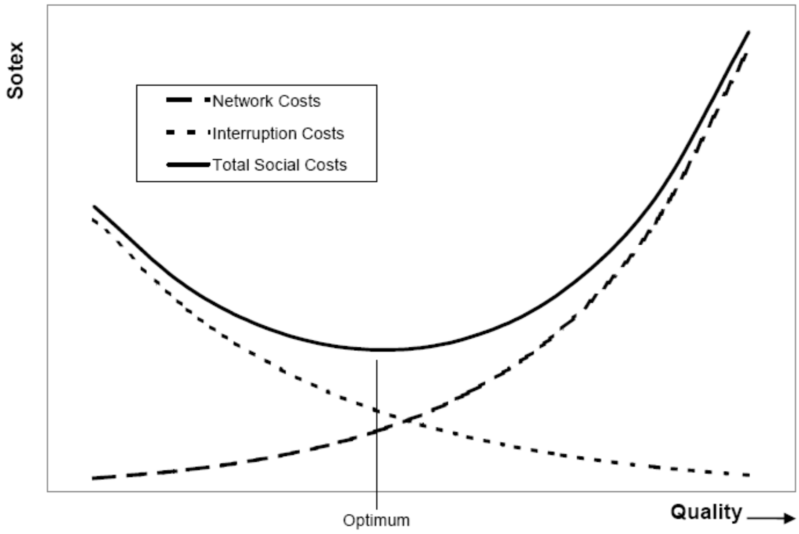


Figure 2.2: Concept of optimal quality [33]

# CHAPTER 3

## PROPOSED METHODOLOGY

### 3.1 Customer Survey

Many methods have been presented to determine outage costs in distribution companies. Some papers present methods to compose interruption costs using actual interruption data and customer interruption costs were other studies contacting the costumer directly to measure outage costs through questionnaire. Each method has some limitation to cover required data but contacting the customer will show his satisfaction and if he is willing to pay more in order to avoid interruptions.

The assumption behind customer survey approach is that customers are in the best position to assess their losses due to supply interruption So, the outage cost is closely related to the ways  customers' different operating activities depend upon a continuous power supply [13]. This dependence is a function of different customer and interruption characteristics which include customer type, activities interrupted, size of customer operation, customer demand, energy requirements, energy dependency according to time of day and year, duration, frequency of interruptions, time of occurrence, partial versus complete interruption, advance notice warning is given or not, the nature of the warning and whether the interruption is localized or widespread [34].

The survey questions have been framed to gather the information regarding the residential consumers view on supplied power, their demand, consumption level. Requested data required to develop the correlation between the interruption outage cost and the outage characteristics such as outage duration, frequency, time of occurrence, seasonal variations, household activities, etc.

Survey outline consist of the following:

- Survey will be made for residential customers.
- Survey questions should cover customer satisfaction, outage cost, and WTP.
- Customer will be asked about
    a. General characteristics (No. of family members, house type, appliances they have, business conducted from home,.. etc ).
    b. Energy requirements
    c. Interruption characteristics such as duration, frequency, time of occurrence, advance warning, etc.
    d. Damages due to power outages

The Questionnaire has been designed to be simple and easy to be completed. It contains 28 questions. Questionnaire can be conducted in different ways:

- Manually using in-person interview.
- By Email.
- Through utility company.
- Using internet website.

Each methodology has advantages and disadvantages in terms of cost, accuracy of data, respondent burden, and the time it takes to gather all the data. Website is adapted since it will take shorter time to complete, cover the responder privacy and easy to communicate with wide range of people. Also, collection of responses will be easier by exporting the result to MS Excel.

A typical respondent data have been illustrated on figure 3.1 where the respondent asked about the frequency of electrical outages faced within one year. Only 14% of the respondent experience more than 3 interruption outages within a period of 12 months.

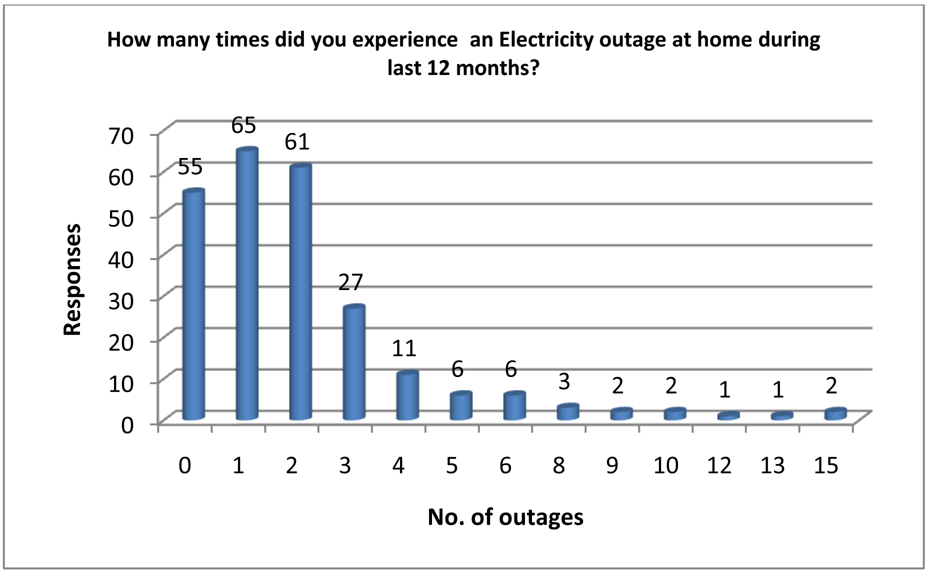


Figure 3.1: Example of typical respondent data

### 3.2 Willing to Pay

This approach is one of the direct measurement approaches where the survey asks what an outage cost to the customer and how much the customer can pay to avoid such outages.

Reference to the survey, correlation between responses willingness to pay in order to avoid outages and other parameters will provide us with a clue as to how well the value of one variable can be predicted from the value of the other. The correlation is equal to the average of the product of two random variables and is defined as

$$cor(X,Y) = E[X\,Y] = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} xyf(x,y)dxdy \qquad (3.1)$$

Correlation coefficient will give the linear relationship between the variables. The correlation coefficient of two variables is defined in terms of their covariance and standard deviation as shown below.

$$\rho = cov(X,Y)/\sigma_x\sigma_y \qquad (3.2)$$

$$-1 \leq \rho \leq 1$$

This provides quick and easy way to view the correlation between the variables. If there is no relationship between the variables then the correlation coefficient will be zero and if there is a perfect positive match it will be one. If there is a perfect inverse relationship, where one set of variables increases while the other decreases, then the correlation coefficient will be negative. Mathematically, covariance is often written as σ and is defined as

$$cov(X,Y) = \sigma_{xy} = E[(X - \bar{X})(Y - \bar{Y})] \qquad (3.3)$$

This can also be reduced and rewritten in the following two forms:

$$\sigma_{xy} = \overline{(xy)} - (\bar{x})(\bar{y}) \qquad (3.4a)$$

$$\sigma_{xy} = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty}(X - \bar{X})(Y - \bar{Y})f(x,y)dxdy \qquad (3.4b)$$

### 3.3 Electrical Power Un-served

Based on the survey results, statistical calculation has been made to measure the cost of un-served power for residential customers. This model calculates the average un-served kWh per customer as shown in below formula and reference to the flowchart in figure 3.2.

$$kwh\ unserve = \frac{Watts}{1000} \times No.of\ appliances \times \%\ of\ appliances\ used \times avrage\ duration\ per \min \times No.of\ outages \div 60\ min \qquad (3.5)$$

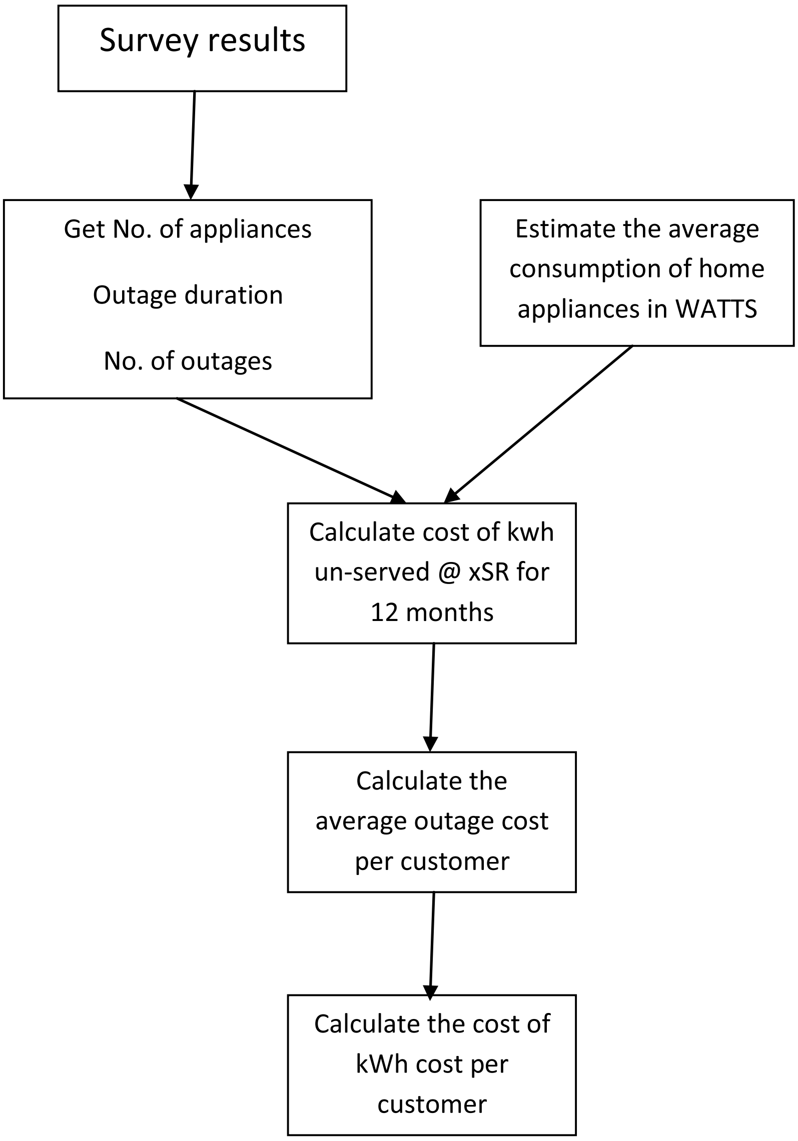


Figure 3.2: Flow chart for calculation of kWh un-served

### 3.4 Damages Costs

In developing the model of damage cost, total cost which comprises several types of damages for industrial, business and residential customers can be included within one of the following categories:

1. Salary or work payment.
2. Cost of loss of profit opportunity.
3. Overtime payment.
4. Cost of loss of raw material.
5. Cost of re-starting the process.
6. Cost of damaged equipment.

The damage costs may vary with interruption duration until they reach to a certain level where the damage cost could be constant. For example, if the working time for a commercial customer is 10 hours per day and an interruption occur during his working hours, cost of production losses will continue increasing till the working hour end then loss will be fixed for that day.

# CHAPTER 4

## SURVEY STUDY FOR THE RESIDENTIAL POWER OUTAGES

This case study is based on survey-based method done for Saudi Arabian residential customers. The objective of this survey is to measure the cost of outages in residential area and to measure their willing to pay in order to avoid electricity outages. The survey is done through web based survey and link had been distributed through Email to large group of people within kingdom. The survey contains 28 questions to measure customer satisfaction and willingness to pay in order to avoid power interruption. In overall, 242 responses were received within 4 weeks. The web site used for posting the survey is http://www.esurveyspro.com/ . Survey is presented in appendix A

### 4.1 kWh Un-served

Customers have been asked many questions to evaluate the cost of outage cost as follow:

- House type
- Air-condition type

- Lighting type
- No. of appliances
- Time of electricity outages (day/night)
- Season of electricity outages (summer/winter)
- Average duration for electricity outages
- No. of outage during last 12 months
- Is he conducting any commercial business at home?
- Do they have any medical equipment?

Table 4.1 shows the statistical analysis for above characteristics in terms of mean, variance, median, standard deviation, minimum and maximum. For example, considering number of appliances in the house, table shows that electrical ovens has the mean of 0.85 with variance of 0.32 and stander deviation of 0.57. Average number of electricity outages during 12 months is 2.04 outages per year with variance of 5.8 and stander deviation of 2.4.

TABLE 4.1: Statistical Calculation for KWH Un-Served Related Characteristics

| Characteristic | | mean | Variance | median | STD | min | max |
|---|---|---|---|---|---|---|---|
| No. of appliances? | Refrigerators | 1.4463 | 0.7378 | 1 | 0.8589 | 0 | 6 |
| | Freezers | 0.9132 | 0.4779 | 1 | 0.6913 | 0 | 4 |
| | Dishwashers | 0.2562 | 0.1997 | 0 | 0.4468 | 0 | 2 |
| | Electrical ovens | 0.8554 | 0.3234 | 1 | 0.5687 | 0 | 3 |
| | Washers | 1.1942 | 0.2982 | 1 | 0.5461 | 0 | 4 |
| | Dryer | 0.8306 | 0.299 | 1 | 0.5468 | 0 | 3 |
| | Air conditioners | 6.1983 | 21.7696 | 6 | 4.6658 | 0 | 25 |
| | Electrical Heating | 1.5413 | 7.3614 | 1 | 2.7132 | 0 | 25 |
| | Water heater | 2.5413 | 4.3821 | 2 | 2.0933 | 0 | 13 |
| | Space heater | 0.6198 | 2.5603 | 0 | 1.6001 | 0 | 15 |
| | Vacuum cleaner | 1.2562 | 0.4154 | 1 | 0.6445 | 0 | 3 |
| | TV | 2.2727 | 2.1909 | 2 | 1.4802 | 0 | 8 |
| | Sauna | 0.0289 | 0.0531 | 0 | 0.2304 | 0 | 3 |
| | Swimming pool | 0.0413 | 0.0647 | 0 | 0.2543 | 0 | 3 |
| | Elevator | 0.0372 | 0.0443 | 0 | 0.2104 | 0 | 2 |
| Time of electricity outages? {No outage=0, day=1, night=2} | | 0.7273 | 0.3983 | 1 | 0.6311 | 0 | 2 |
| Time of electricity outages? {No outage=0, summer=1,winter=2} | | 0.7686 | 0.2699 | 1 | 0.5195 | 0 | 2 |
| Average duration for electricity outages? {in minutes}} | | 72.3802 | 18473.95 | 50 | 135.9189 | 0 | 1440 |
| No. of outage during last 12 months? | | 2.0455 | 5.8029 | 2 | 2.4089 | 0 | 15 |

Based on survey results and equation 3.5, the total kWh un-served will be calculated following the flow chart shown in figure 3.2 at a cost of SAR0.05 per kWh. An estimated appliance consumption have been used to evaluate the un-served kWh as per table 4.2. If we assume that all the home appliances are working at the same time, the total power consumption for all the 242 responders will be 8,381,775 watts. By considering the cost of SAR0.05/kwh, total consumed energy for 30 days (24 house a day) is 301,680 kwh. Total electricity bills for all respondents is SAR123,150. The ratio of total electricity bills to total energy consumption will be the estimated percentage of working appliances during the day. This is shown in equation 4.1. The estimated percentage of working appliances out of the total house appliances have been calculated to be 41% of the appliances as shown in table 4.3.

$$\%\ of\ appliances\ working\ normaly = \frac{avarage\ electricity\ bill\ value}{(Total\ expected\ consumbtion\ of\ all\ appliances\ 24hour, 30days)} \tag{4.1}$$

TABLE 4.2: Home Appliances Estimated Consumption in WATTs

| Appliance | Watt |
|---|---|
| Refrigerators | 400 |
| Freezers | 225 |
| Dishwashers | 1500 |
| Electrical ovens | 6000 |
| Washers | 750 |
| Dryer | 2000 |
| Air conditioners | 2500 |
| Electrical Heating | 2000 |
| Water heater | 1500 |
| Space heater | 2500 |
| Vacuum cleaner | 1200 |
| TV | 80 |
| Sauna | 3000 |
| Swimming pool | 1500 |

TABLE 4.3: Bases for Percent of Appliances Used in the Houses

| | |
|---|---|
| Total consumption (WATT) | 8,381,775 |
| Total Consumption KWh (@ 0.05 SAR kWh cost) | 419 |
| Total Consumption KWH for 30 days (24 hours) | 301,680 |
| Total electricity bills for all respondents (average) - SAR | 123,150 |
| % of appliances used during 1 month | ≈ 41% |

From the survey, The average outage duration for all customers within 12 months is calculated to be 72.38 minutes and with almost 2 outages per year in average. The total respondent cost of un-served power for 41% of the load is SAR1,427.72. Based on this, Table 4.4 shows that one hour un-served energy will cost SAR2.00 per customer.

To show similar literature studies results, table 4.5 illustrate Cross-comparison of interruption cost studies. All costs are normalized per kWh non-delivered energy and are expressed in 2004 US dollars [12]. The literature shows that the cost for the kwh calculated by A. M. SHAALAN in 1988 using the survey method was SAR4.84 (USD1.29) compare to SAR2.00 ($0.53) in this study.

TABLE 4.4: Un-Served kWh Cost Calculation

| | |
|---|---|
| Total cost of kWh un-served @ 0.05 SAR and 41% of the total appliances load (for 242 responses) | 1427.72 |
| Average outage duration per customer within 12 months | 72.38 min. |
| Average No. of outages per customer within 12 months | 2 outages/year |
| Cost of kWh un-served @ 0.05 SAR @ 41% of the appliances load per customer (period of 12 months) | 2.419 SAR |
| One hour outage will cost | 2.00 SAR |

TABLE 4.5: Cross-Comparison of Interruption Cost Studies [12]

| | Methodology | Year | Country | USD / kWh |
|---|---|---|---|---|
| ***Residential*** | | | | |
| Upadhyay (1996) | Survey | 1996 | India | 0.23 |
| Sarkar and Shreshta (1996) | Survey | 1988 | India | 0.26 |
| Tavanir (1995) | Survey | 1995 | Iran | 2.60 |
| De Nooij et al. (2003) | GDP | 2003 | The Netherlands | 19.35 |
| KEMA (2003) | Survey | 2003 | The Netherlands | 22.99 |
| Young (1987) | Survey | 1987 | New Zealand | 5.25 |
| Turner (1977) | Proxy | 1977 | New Zealand | 1.83 |
| Trengereid (2003) | Survey | 2003 | Norway | 0.48 |
| Shalaan (1989) | Survey | 1988 | Saudi Arabia | 1.29 |
| Andersson and Taylor (1986) | Survey | 1980 | Sweden | 4.18 |
| Lolander (1948) | N/A | 1948 | Sweden | 2.25 |
| Swedish Joint Commission (1969) | Direct | 1969 | Sweden | 4.91 |
| UNIPEDE (1972) | Survey | 1970 | Sweden | 4.30 |
| Sheppard (1967) | Proxy | 1965 | UK | 2.81 |
| UNIPEDE (1972) | Proxy | 1970 | UK | 8.34 |
| Burns and Gross (1990) | Survey | 1988 | USA | 6.70 |
| Krohm (1978) | Black Out | 1978 | USA | 2.88 |
| Faucett et al. (1979) | Black Out | 1979 | USA | 0.13 |
| Sanghvi (1982) | Survey | 1980 | USA | 0.56 |
| **T. Al-Malki** | **Survey** | **2011** | **Saudi Arabia** | **0.53** |

The survey shows 93% of the outages happened during summer and 84% occurs during the day where 70% of the customers did not receive prior notification before the outage accrue as illustrated in figure 4.1 and figure 4.2.

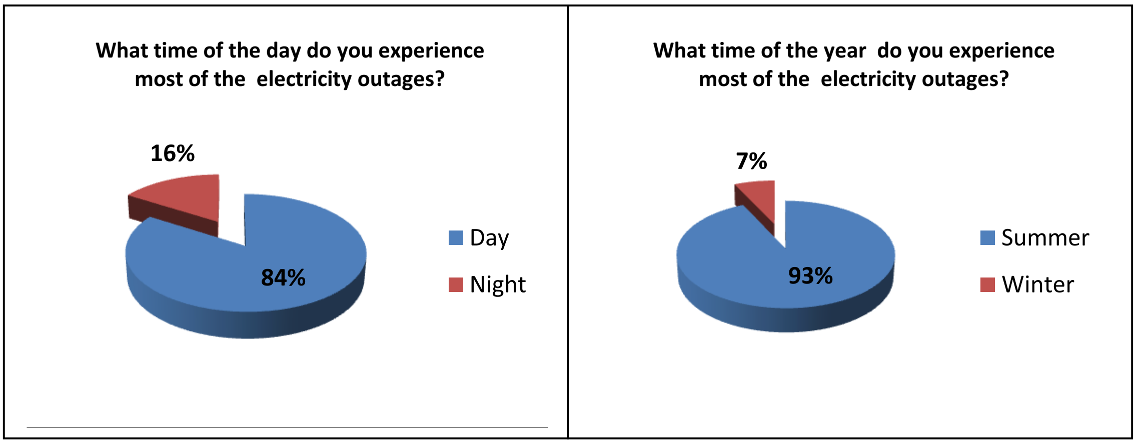


Figure 4.1: No. of outages vs. time of occurrence

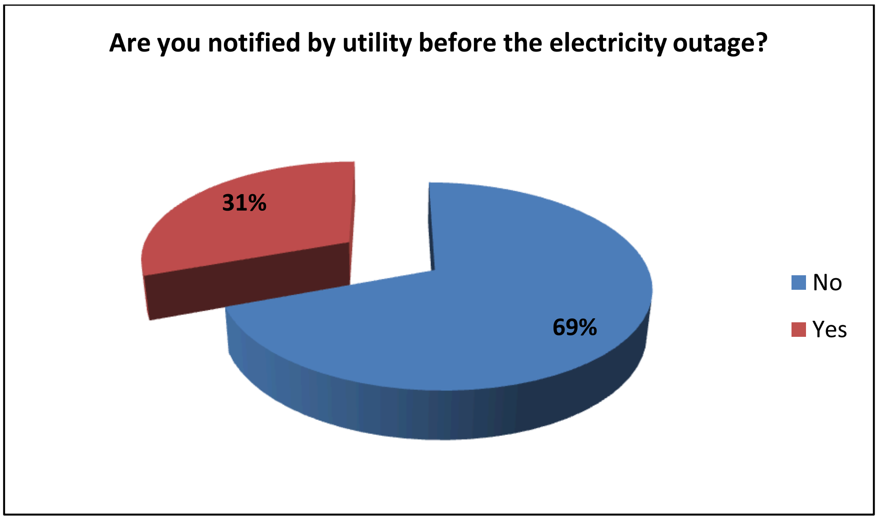


Figure 4.2: Utility notification prior the outages

Outage duration and number of outages are important factors for estimation of outage costs. Figure 4.3 shows that 79% of the outages duration is between 10 to 180 minutes and with average of 72 minutes. The number of outages happened less than 3 times a year cover 67% from the survey sample as shown in figure 4.4. The average number of outages per customer is 2 outages per year.

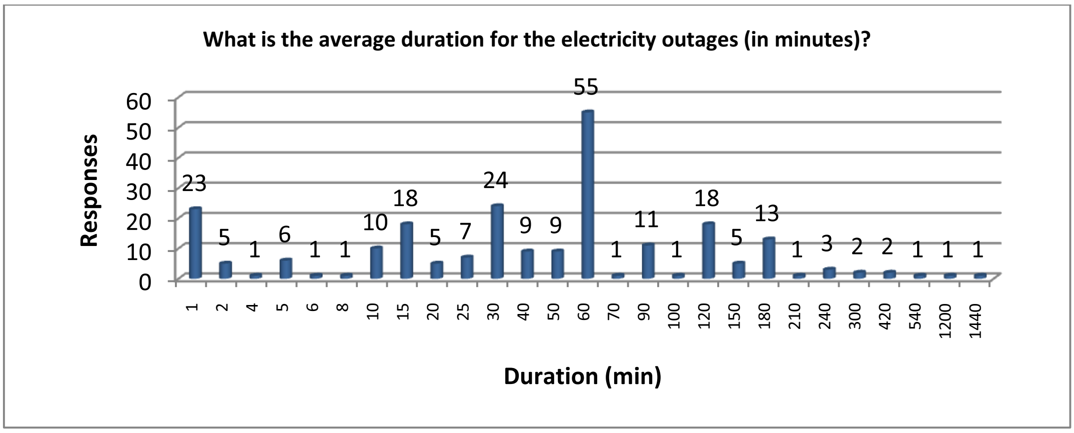


Figure 4.3: Duration of the electricity outages distribution

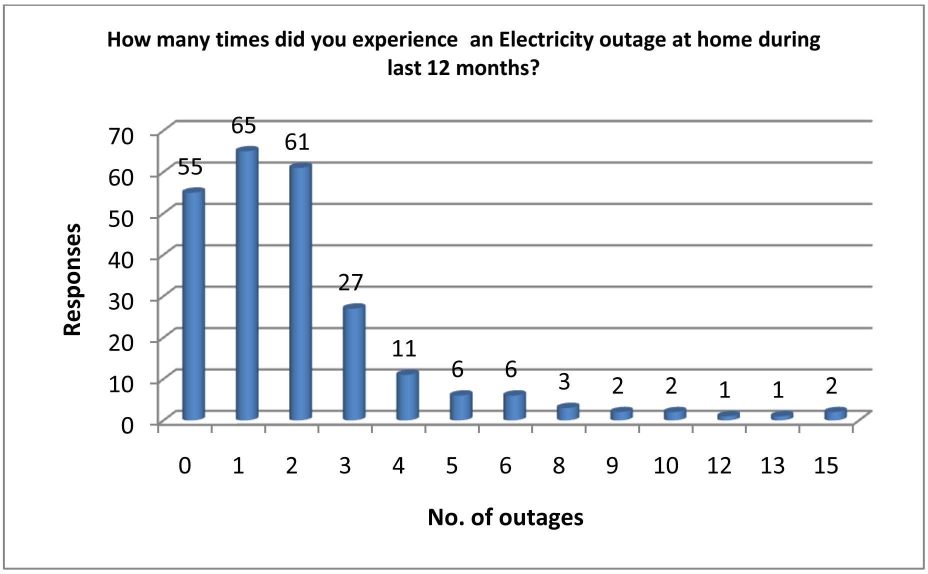


Figure 4.4: No. of experienced outages within 12 months

Survey results show the following statistics:

- Residential customers house member varies between 1 and 16 with an average of 6 member per family (Figure 4.5).
- 24.8% of the houses have at least 1 member over 60 year age (Figure 4.6).
- 88.4% of responses say that they are available at home most of the time (Figure 4.7).
- Normally, no business activities are conducted from home as illustrated in figure 4.8.
- 13% of the responses confirm that they are using medical equipment at home as per figure 4.9.
- Heat insulation is used in 57.8% of the residential houses (Figure 4.10).

- Very few injures happened due to power outages (5.4%) and most of it are minor injuries (Figure 4.11).

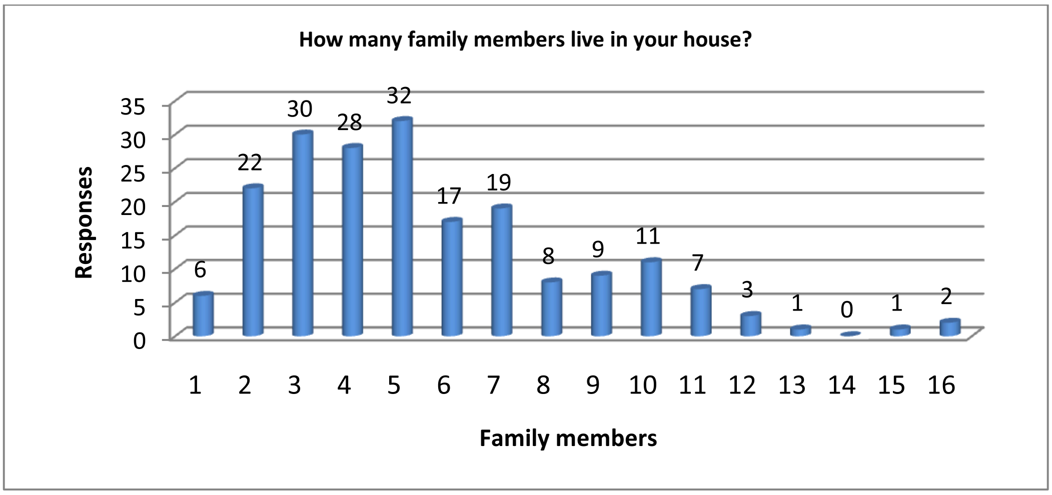


Figure 4.5: Family members for survey sample

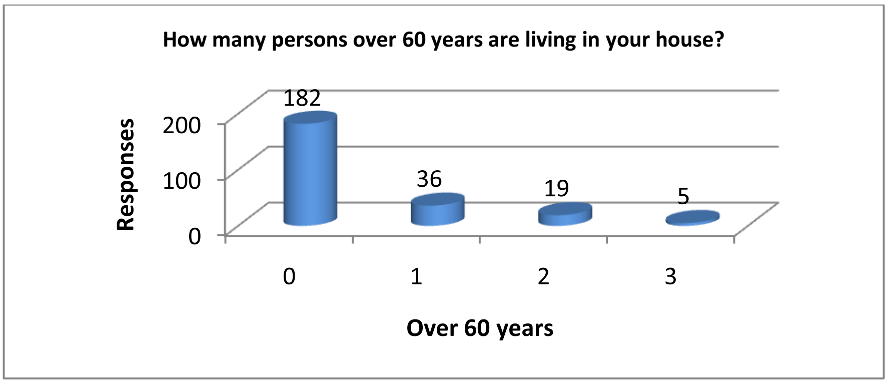


Figure 4.6: Family members with over 60 years of age

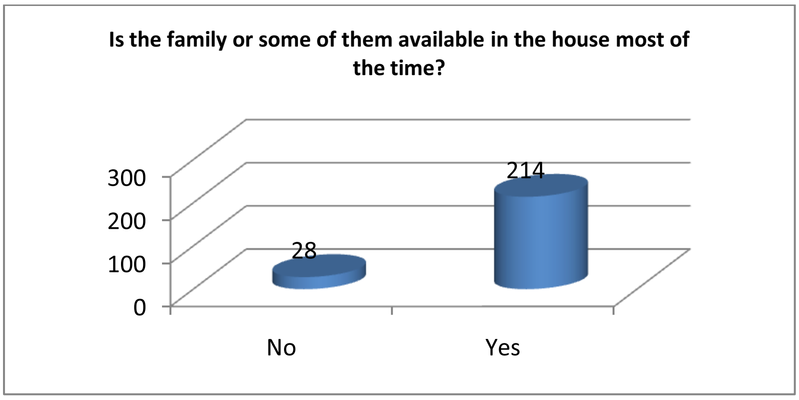


Figure 4.7: Distribution of the availability of family members


Figure 4.8: Commercial business conducted at home

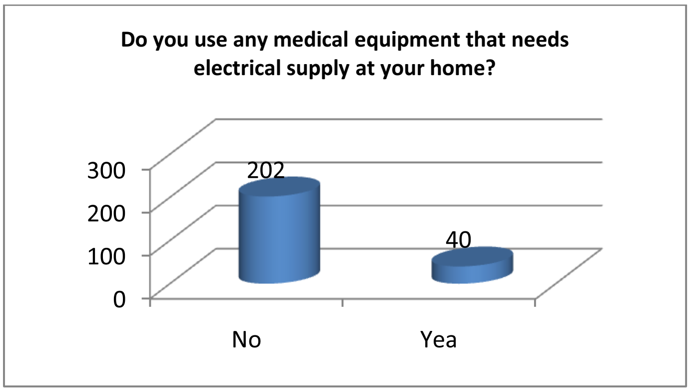


Figure 4.9: Medical equipment used at home

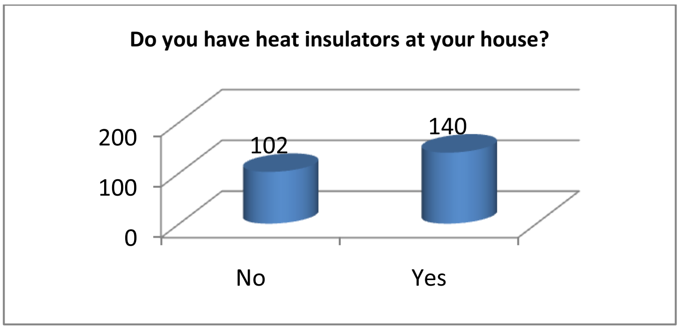


Figure 4.10: 57.8% of the sample having heat insulators

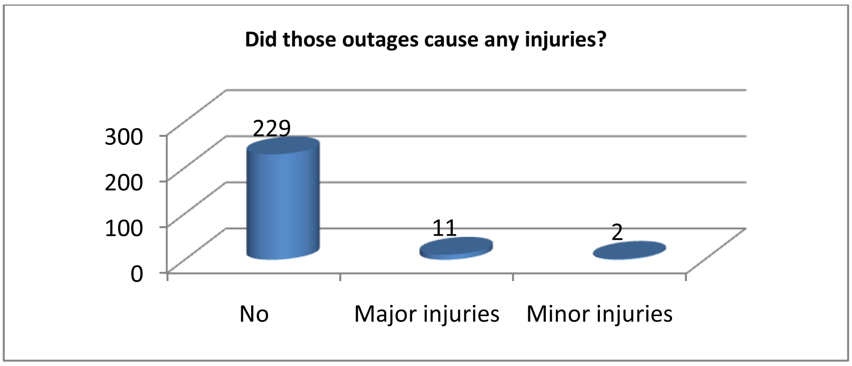


Figure 4.11: Injuries caused during power outages

By asking the residential customers which duration of  an outages they consider to be acceptable,  around 67% of the customer accepting an outage duration between 30 seconds and 15 minutes. Figure 4.12 and 4.13 show the outage duration variations and customer acceptance.

Figure 4.14 shows the residential customer classification of power quality supply as low or acceptable in terms of number of outages per year. 64 respondents who represent 26.4% considering the power supply quality is low if they experience one outage within 2 years. 84 respondents who represent 34.7%  are considering  the power supply quality is low if they experience 1 to 2 outages a years.

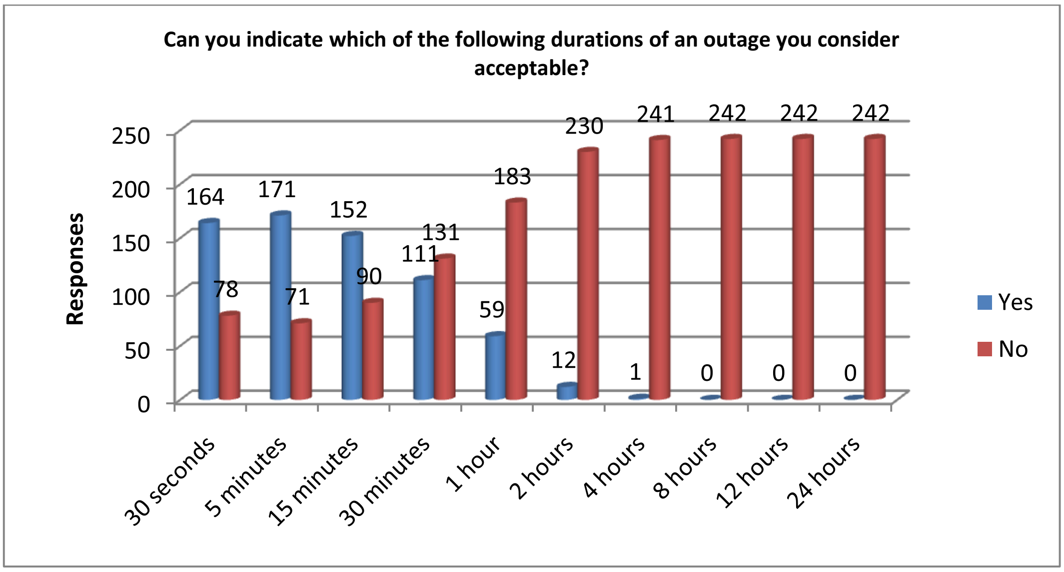


Figure 4.12: Acceptable outage duration for residential customers

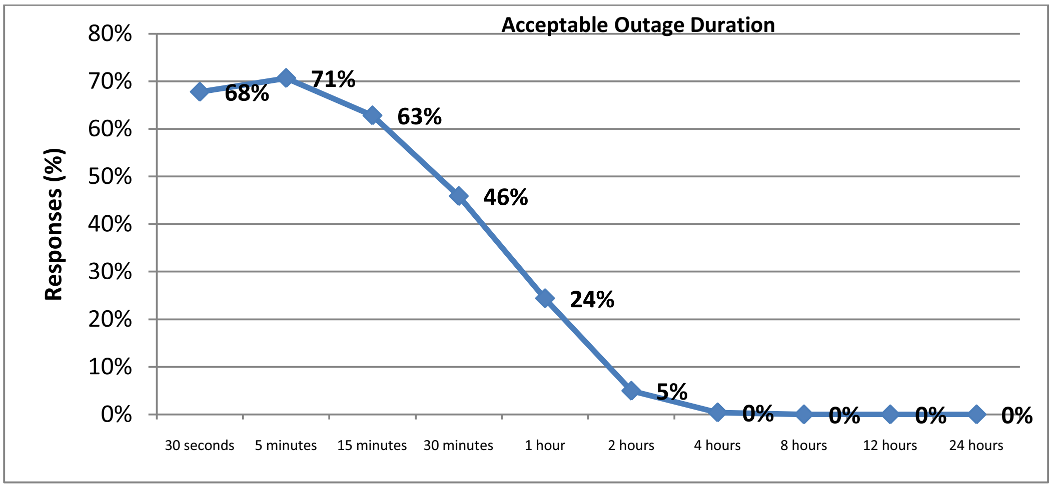


Figure 4.13: Average of Acceptable outage duration for residential customers

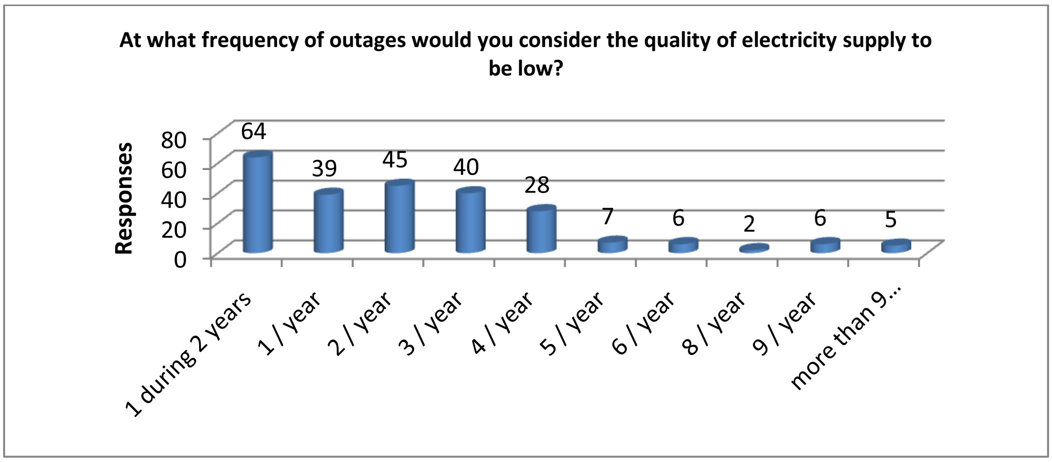


Figure 4.14: Distribution of No. of electricity outages that are acceptable to residential customer

## 4.2 Damages Cost

Damages cost can be calculated by asking direct questions to the customer about any damages that happened due to power interruption. The survey concentrate on the appliances and food damages and statistical analysis are shown in table 4.6. Table 4.7 illustrate the average damage costs per customer within 12 months which is calculated to be 552.03 SAR.

TABLE 4.6: Statistical Analysis for Damages Cost

| | mean | Variance | median | STD | min | max |
|---|---|---|---|---|---|---|
| **Damages of appliances? {Yes=1, No=0}** | 0.1612 | 0.1357 | 0 | 0.3684 | 0 | 1 |
| **Damages during last 12 Months? {SAR}** | 420.5455 | 8330016 | 0 | 2886.177 | 0 | 43000 |

TABLE 4.7: Damages Cost

| | |
|---|---|
| Cost of appliances damages per customer within 12 months | 420.54 SAR |
| Cost of food damages per customer within 12 month | 131.49 SAR |
| Total damages cost per customer within 12 month | 552.03 SAR |

### 4.3 Willingness to Pay

To study customer willingness to pay, correlation coefficient has been calculated to measure the linear relationship between WTP and below values:

- At what frequency of outages would customer consider the quality of electricity supply to be low
- Time of outages (day/night)
- Season of outages (summer/winter)
- Duration of outages
- Number of outages per year
- Is there any appliances damages
- Cost of damaged
- Monthly income

Table 4.8 shows the statistical analysis for the relation between outage frequency and WTP. If we consider the frequency of outages that seems to be acceptable to most of the respondents, it shows that 1 outage per year has the highest mean value. On the other hand, if the outage frequency exceed 2 outages per year, respondent consider the quality of the supply to be low. The survey also shows that 21% of the respondents provide their willingness to pay extra amount to avoid electricity outages with an average of 2.66% out of their monthly electricity bill.

TABLE 4.8: Statistical Analysis for WTP Characteristics

| For willing to pay | | mean | Variance | median | STD | min | max |
|---|---|---|---|---|---|---|---|
| Durations of an outage considered acceptable? | 1 during 2 years | 0.6777 | 0.2193 | 1 | 0.4683 | 0 | 1 |
| | 1 / year | 0.7066 | 0.2082 | 1 | 0.4563 | 0 | 1 |
| | 2 / year | 0.6281 | 0.2346 | 1 | 0.4843 | 0 | 1 |
| | 3 / year | 0.4587 | 0.2493 | 0 | 0.4993 | 0 | 1 |
| | 4 / year | 0.2438 | 0.1851 | 0 | 0.4303 | 0 | 1 |
| | 5 / year | 0.0496 | 0.0473 | 0 | 0.2175 | 0 | 1 |
| | 6 / year | 0.0041 | 0.0041 | 0 | 0.0643 | 0 | 1 |
| | 8 / year | 0 | 0 | 0 | 0 | 0 | 0 |
| | 9 / year | 0 | 0 | 0 | 0 | 0 | 0 |
| | more than 9 outage per year | 0 | 0 | 0 | 0 | 0 | 0 |
| Frequency of outages consider the quality of electricity supply to be low? | | 2.4132 | 4.7248 | 2 | 2.1737 | 0.5 | 10 |
| WTP? (Yes=1, No=0) | | 0.2107 | 0.167 | 0 | 0.4087 | 0 | 1 |
| How much the customer can pay to get better service? (%) | | 2.657 | 103.8362 | 0 | 10.19 | 0 | 100 |

Table 4.9 shows the correlation coefficients measured for some expected factors that may affect customer WTP. The table present some negative and positive correlation between interruption characteristics and WTP. Time of outages, season of outages, duration of outages and damages shows negative correlation or inverse relation with respect to willing to pay (WTP). On the other hand, frequency of outages per year and monthly income are showing positive correlation which means that residential consumers are willing to pay if they are facing frequent outages.

TABLE 4.9: Correlation Coefficient Between WTP and Other Factors

| | |
|---|---|
| Frequency of acceptable outages | 0.058 |
| Time of outages (day/night) | -0.0658 |
| Season of outages (summer/winter) | -0.0234 |
| Duration of outages | -0.0101 |
| No. of outages per year | 0.0239 |
| Is there any appliances damages? | -0.1438 |
| Cost of damages | -0.0191 |
| Monthly income | 0.1905 |

Figure 4.15 and 4.16 shows the distribution of customers WTP and bidding values to avoid power outages.

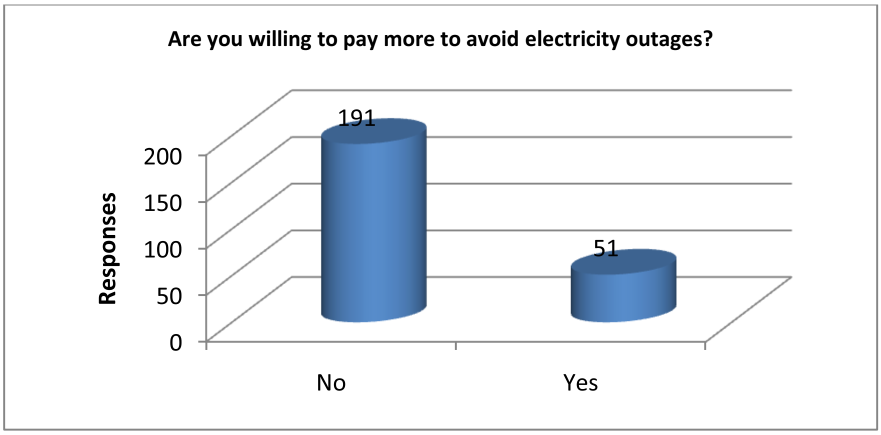


Figure 4.15: Willing to pay distribution

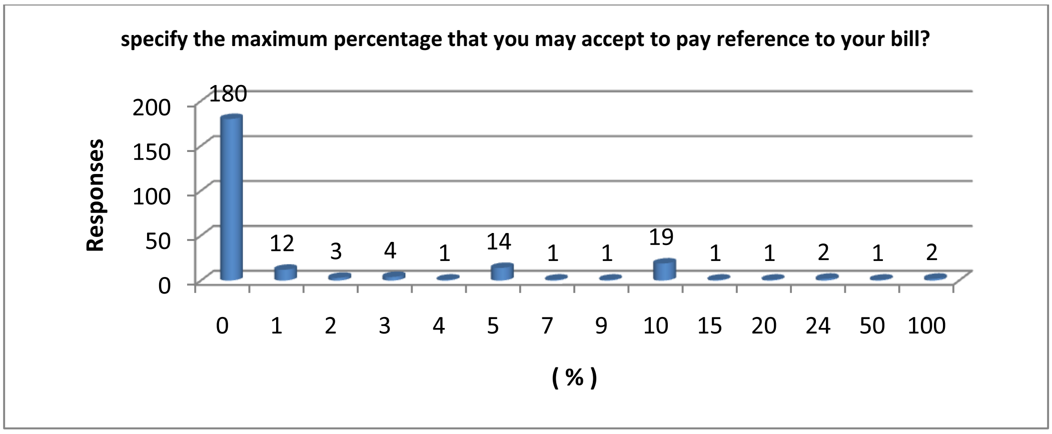


Figure 4.16: WTP: bids as percentage from regular electricity bill

## 4.4 KPI's

Below KPI's have been calculated and compared to 2007 situation in Saudi Arabia based on the survey outcome:

- System Average Interruption Duration Index (SAIDI)
- System Average Interruption Frequency Index (SAIFI)
- Momentary Average Interruption Frequency Index (MAIFI)
- Customer Average Interruption Duration Index (CAIDI)

Results obtained by using equation 2.8, 2.9, 2.10, 2.11. Table 4.10 shows the survey results compare with Saudi Arabia KPIs measured on 2007. Total customer interruption duration over total number of customer served is calculated to be 72.38 minutes. Total customer interruption over total number of customer served is calculated to be 0.77 interruption yearly.

TABLE 4.10: Comparison of the 2007 Situation in Saudi Arabia with Exist KPI Performance [12]

| KPI | SEC West | SEC East | SEC Centre | SEC South | MARAFIQ | Short term target (3 years) | long term target (6 years) | Median international | **Survey Results** |
|---|---|---|---|---|---|---|---|---|---|
| SAIDI (min.) | 38.4 | 65.4 | 80.2 | 214.8 | 67 | 150 | 120 | 153 | **72.38** |
| SAIFI (#/yr) | 1.13 | 1.71 | 2.09 | 5.19 | 0.9 | 2 | 2 | 1.9 | **0.77** |
| MAIFI (#/yr) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 2.01 | **0.095** |
| CAIDI (min.) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | **93.67** |

# CHAPTER 5

## SURVEY STUDY FOR THE INDUSTRIAL POWER OUTAGES

### 5.1 Overview

An additional work has been done for industrial customers as follow:

a. Survey questions have been conducted to cover customer satisfaction, outage cost, and WTP.
b. Customer have been asked about
    - Voltage level and emergency consumption
    - Disturbance/outages
    - Load situation
    - Willingness to pay

- After defining the target customers and the required information, the questionnaire was designed to cover all above points and to be simple to answer. The industrial survey is contains 15 questions.
- Questionnaire had been dispatched using web site link distributed through Email to many industrial companies in Jubail and Dammam.

- In overall, only 4 responses were received within 6 weeks. Web site used for posting the survey is http://www.esurveyspro.com/ . Survey questions are presented in table 5.1.

### 5.2 Results

Due to very low response from industrial customer, no conclusion can be drawn. Hence, the customer responses are given in table 5.1. The main question here is that are they willing to pay in order to avoid interruption?. Three out of four say yes even if they did not affected by unexpected outages.

TABLE 5.1: Industrial Survey Results

| Sr. | Question | Respnce#1 | Respnce#2 | Respnce#3 | Respnce#4 |
|---|---|---|---|---|---|
| **1** | **subscribed voltage level** | 230kv | 4.16 kv- 13.8 kv | 230kv | 69 kv -132 kV |
| **2** | **maximum load** | More then 10 MW | More then 10 MW | 5001kw - 10000kw | More then 10 MW |
| **3** | **total energy consumption for one month** | More than 500Mwh | More than 500Mwh | 50 – 100 Mwh | More than 500Mwh |
| **4** | **affected by unexpected outages** | less than 2 per year | less than 2 per year | no | no |
| **5** | **length of these outages** | less than 1 min | less than 1 min | less than 1 min | less than 1 min |
| **6** | **affected by ‘inexplicable’ disturbances that could not be explained by external influences** | yes | no | no | no |
| **7** | **estimate the frequency of occurrence** | Only during abnormal weather conditions. Once every 3 years | - | - | - |
| **8** | **equipment being damaged** | no | no | yes | no |
| **9** | **operational situation** | 24 hrs operation | 24 hrs operation | 24 hrs operation | 24 hrs operation |
| **10** | **types of loads** | motors(mediun & low voltage), lighting,electrical heating, load with recifiers | motors(mediun voltage), electrical heating, load with recifiers | motors(mediun & low voltage), lighting,electrical heating, load with recifiers | motors(mediun & low voltage), lighting,electrical heating, load with recifiers |
| **11** | **emergency (standby) power units** | yes, 1MVA | - | - | diesel , 2650KVA |
| **12** | **control equipment installed** | - | no | - | |
| **13** | **grid-owner inform you about changed situations in the running of the network** | no | yes | no | yes |
| **14** | **willing to pay** | no | yes | yes | yes |
| **15** | **maximum percentage rate out of your annual electrical bill** | - | - | - | 10% |

# CHAPTER 6

## CONCLUSION

In this thesis, a survey has been accomplished for Saudi Arabia residential customers. The aim of this is to estimate the power outage costs and customer willingness to pay in order to avoid these outages.

242 responses have been received for residential survey. Power outage cost has been obtained by calculating kWh un-served and appliances or food damages. The cost of kWh un-served is 2 SAR ( $0.53). Appliances damages has been calculated for period of 12 months to be in average 552 SAR ($147.2).

Willingness to pay studied shows that 21% of the residential customer accept the idea. Reasons for this decision couldn't be defined since all correlation studies show low correlation between customers WTP and assigned factors in section 4.3. hence, for this survey, residential customers impacted by their emotional not by facts.

Performance KPI's have been calculated for SAIDI, SAIFI, CAIDI, and MAIFI which have been compared Saudi Arabia KPI's reading during 2007.

In future, there is a plan to continue what have been started for industrial customer survey and to study the impact of interruptions and outages on their investment planning and on the quality and quantity of their production.

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# APPENDIX

# Appendix A.1: Residential Questionnaire

## Questionnaire - أستبيان

Dear Participant,

This is a Master Thesis questionnaire requested to get MS degree in Electrical Engineering. The purpose of this survey is to measure the power quality of electrical supply for residential customer in Saudi Arabia. I would be grateful if you could spare a few minutes to provide your input by answering the questionnaire.

The questionnaire has been carefully designed so that it will not take much of your time to fill it out.

السلام عليكم و رحمه الله و بركاته

مرفق بالأسفل استبيان حول جودة الخدمة الكهربائية المقدمة للمناطق السكنية في المملكة العربية السعودية. الهدف من إرسال هذا الاستبيان الحصول على بعض المعلومات التي ستساعدني في استكمال بحث الماجستير في الهندسة الكهربائية.

البحث معد بطريقة سهله ولا يستغرق أكثر من دقائق.

لأي استفسار بإمكانك مراسلتي على العنوان التالي:
survey.site@ymail.com

| | |
|---|---|
| 1. How many family members live in your house?<br>كم عدد افرد العائلة في المنزل؟ | |
| 2. How many persons over 60 years are living in your house?<br>كم عدد الأشخاص في المنزل الذين تزيد أعمارهم عن 60 عام؟ | |
| 3. Is the family or some of them available in the house most of the time?<br>هل أفراد العائلة أو بعضهم متواجدون في المنزل أغلب الأحيان؟ | ☐ Yes / نعم<br>☐ No / لا |
| 4. Do you conduct any commercial business from home?<br>هل تقوم بأي أعمال تجارية من المنزل؟ | ☐ Yes / نعم<br>☐ No / لا |
| 5. Do you use any medical equipment that needs electrical supply at your home?<br>هل تستخدم أي أجهزة طبية كهربائية في المنزل؟ | ☐ Yes / نعم<br>☐ No / لا |
| 6. Which type of Air-Conditioning you are using?<br>ما نوع أجهزة التكييف المستخدمة في منزلك؟ | ☐ Window type / مكيفات النوافذ<br>☐ Split unit / مكيف جداري<br>☐ Central unit / مكيف مركزي |
| 7. Do you use non-electrical heater at home (Ex: Heater work with Gas, Coal, ...etc)<br>هل تستخدم وسائل تدفئة أخرى لا تعمل بالكهرباء؟ | ☐ Yes / نعم<br>☐ No / لا |
| 8. What type of lighting you have at your house?<br>ما نوع المصابيح المستخدمة في منزلك؟ | ☐ Florescent lamp / مصباح نيون<br>☐ Halogen lamp / مصابيح الهالوجين<br>☐ Incandescent lamp / مصباح وهاج<br>☐ Gas discharge lamp / مصباح تفريغ غازي |

| | |
|---|---|
| 9. What type is your house?<br>ما نوع المسكن الذي تعيش فيه؟ | ☐ Apartment / شقة<br>☐ Villa / فيلا<br>☐ Portable / منزل قابل للنقل<br>☐ Compound / مجمع سكني |
| 10. Do you have heat insulators at your house?<br>هل يوجد عوازل للحرارة في منزلك؟ | ☐ Yes / نعم<br>☐ No / لا |
| 11. How many pieces of the appliances below do you have at your home? (put 0 if you don't have)<br>كم عدد الأجهزة المنزلية التي تمتلكها فيما يلي؟ ضع 0 اذا لم يوجد | Refrigerators / ثلاجة ☐<br>Freezers / فريزر ☐<br>Dishwashers / غسالة صحون ☐<br>Electrical ovens / فرن كهربائي ☐<br>Washers / غسالة ملابس ☐<br>Dryer / نشافة ☐<br>Air conditioners / مكيف ☐<br>Electrical Heating / جهاز تدفئة كهربائي ☐<br>Water heater / سخان ماء ☐<br>Vacuum cleaner / مكنسة كهربائية ☐<br>TV / تلفزيون ☐<br>Sauna / ساونا ☐<br>Swimming pool / حمام سباحة ☐<br>Elevator / مصعد ☐ |
| 12. What time of the day do you experience most of the electricity outages?<br>في أي وقت من اليوم تواجه انقطاع التيار غالبا؟ | ☐ Day / نهارا<br>☐ Evening / ليلا<br>☐ I did not face any outage / لم اواجه اي أنقطاع |
| 13. What time of the year do you experience most of the electricity outages?<br>في أي وقت من السنة تواجه انقطاع التيار غالبا؟ | ☐ Summer / صيفا<br>☐ Winter / شتاء<br>☐ I did not face any outage / لم اواجه اي أنقطاع |
| 14. Are you notified by utility before the electricity outage?<br>هل يتم تبليغك بالانقطاع قبل حدوثه؟ | ☐ Yes / نعم<br>☐ No / لا |
| 15. What is the average duration for the electricity outages (in minutes)?<br>ما هو معدل الوقت الذي يستمره الانقطاع الكهربائي بالدقائق؟ | |
| 16. How many times did you experience an Electricity outage at home during last 12 months?<br>كم عدد الأنقطاعات الكهربائية التي واجهتها في المنزل خلال 12 شهر الماضية؟ | |
| 17. Did those outages cause any damages to your home appliances?<br>هل سببت تلك الانقطاعات أي تلفيات في أي من أجهزة المنزل؟ | ☐ Yes / نعم<br>☐ No / لا |
| 18. How do you evaluate/estimate the appliances damages during last 12 Months in SAR?<br>كم تقيم مجموع التلفيات التي حدثت في الأجهزة المنزلية خلال 12 شهر الماضية بسبب انقطاع التيار الكهربائي بالريال؟ | |

| | |
|---|---|
| 19. Did those outages cause any injuries?<br>هل سبب أي من انقطاعات التيار في إصابات في المنزل؟ | ☐ Yes / نعم<br>☐ No / لا |
| 20. If yes, How serious are these injuries?<br>إذا كانت الإجابة السابقة نعم, ما هي نوعية الإصابة؟ | ☐ Scratches / خدوش<br>☐ Minor injuries / جروح طفيفة<br>☐ Major injuries / جروح بليغة<br>☐ Minor burns / حروق طفيفة<br>☐ Severe burns /حروق بليغة<br>☐ Bone fractures / كسور<br>☐ Death / وفاة<br>☐ Other / غير ذلك<br>----------------------------------- |
| 21. How do you evaluate/estimate the cost of food damages during last 12 Months resulting from electricity outages in SAR?<br>كم تقيم مجموع التلفيات التي حدثت في الأطعمة خلال 12 شهر الماضية بسبب انقطاع التيار الكهربائي بالريال؟ | |
| 22. Can you indicate which of the following durations of an outage you consider acceptable?<br>هل ممكن تحديد زمن انقطاع التيار المقبول من وجهة نظرك؟ | ☐ 30 seconds/ثانية<br>☐ 5 minutes/ دقائق<br>☐ 15 minutes/دقيقة<br>☐ 30 minutes/دقيقة<br>☐ 1 hour/ساعة<br>☐ 2 hours/ساعة<br>☐ 4 hours/ساعة<br>☐ 8 hours/ساعة<br>☐ 12 hours/ساعة<br>☐ 24 hours/ساعة |
| 23. At what frequency of outages would you consider the quality of electricity supply to be low?<br>الى أي حد يمكن ان تعتبر بأن جودة الخدمة المقدمه منخفضة؟ | ☐ 1 outage per 2 years / أنقطاع واحد كل سنتين<br>☐ 1 outage per year / أنقطاع واحد كل سنة<br>☐ 2 outages per year / أنقطاعين كل سنة<br>☐ 3 outages per year / ثلاث أنقطاعات كل سنة<br>☐ 4 outages per year / أربع أنقطاعات كل سنة<br>☐ 5 outages per year / خمس أنقطاعات كل سنة<br>☐ 6 outages per year / ستة أنقطاعات كل سنة<br>☐ 7 outages per year / سبعة أنقطاعات كل سنة<br>☐ 8 outages per year / ثمان أنقطاعات كا سنة<br>☐ 9 outages per year / تسعة أنقطاعات كل سنة<br>☐ more than 9 outages per year / أكثر من تسعة أنقطاعات كل سنة |

| | |
|---|---|
| | |
| 24. How much do you pay for the electricity bill monthly (in SAR)?<br>كم مبلغ فاتورة الكهرباء الذي تدفعه شهريا بالريال؟ | ☐ 1 - 100 SR<br>☐ 100 - 200 SR<br>☐ 201 - 300 SR<br>☐ 301 - 500 SR<br>☐ 501 - 750 SR<br>☐ 751 - 1000 SR<br>☐ 1001 - 1500 SR<br>☐ 1501 - 2000 SR<br>☐ 2001 - 3000 SR<br>☐ 3001 - 4000 SR<br>☐ 4001 - 5000 SR<br>☐ More than 5000 SR |
| 25. What is your monthly income (in SAR)? (Optional)<br>ما هو دخلك الشهري بالريال؟ | ☐ Less than 3,000 SR<br>☐ Between 3,000 - 6,000 SR<br>☐ Between 6,000 - 9,000 SR<br>☐ Between 9,000 - 12,000 SR<br>☐ Between 12,000 - 15,000 SR<br>☐ More that 15,000 SR |
| 26. Are you willing to pay more to avoid electricity outages?<br>هل أنت مستعد أن تدفع رسوم أكثر لتتفادى انقطاع التيار الكهربائي؟ | ☐ Yes / نعم<br>☐ No / لا |
| 28. If yes, specify the maximum percentage that you may accept to pay reference to your bill?<br>أذا كان اجابة السؤال السابق بنعم, ما هي أعلى نسبة يمكن ان تدفعها مقارنة باستهلاكك؟ | |

## Appendix A.2: Survey Responses

| Sr. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | No. of appliances | | | | | | | | | | | | | | | Q13 | Q14 | Q15 | Q16 | Q17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Saudi (Yes=1 No-0) | Family members | Over 60 years | available in house most of the time | Commercial business | Medical equipment | Type of AC (w=1,c=2, s=3) | non-electrical heater | Lighting type(F=1,G=2,H=3,I=4) | House type(A=1,C=2,P=3,V=4) | Insulators | Refrigerators | Freezers | Dishwashers | Electrical ovens | Washers | Dryer | Air conditioners | Electrical Heating | Water heater | Space heater | Vacuum cleaner | TV | Sauna | Swimming pool | Elevator | Time of electricity outages (No outage=0, day=1, night=2) | Time of electricity outages (No.outage=0, summer=1,winter=2) | Notification | Average duration for electricity outages (in minutes) | No. of outage during last 12 months |
| **1** | 1 | 2 | 0 | 1 | 0 | 0 | 2 | 0 | 4 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 2 |
| **2** | 1 | 7 | 0 | 0 | 0 | 0 | 3 | 0 | 4 | 4 | 1 | 2 | 2 | 0 | 1 | 1 | 1 | 11 | 4 | 2 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| **3** | 1 | 4 | 0 | 1 | 0 | 0 | 2 | 0 | 3 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 5 | 1 |
| **4** | 1 | 4 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 4 | 0 | 1 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| **5** | 1 | 3 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 4 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 1 | 1 | 120 | 2 |
| **6** | 1 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 7 | 2 | 4 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 1 |
| **7** | 1 | 3 | 0 | 1 | 0 | 0 | 2 | 0 | 4 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 1 | 0 | 180 | 0 |
| **8** | 1 | 6 | 0 | 1 | 0 | 1 | 3 | 0 | 1 | 4 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 8 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 120 | 3 |
| **9** | 1 | 6 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 2 | 1 | 0 | 1 | 1 | 1 | 2 | 2 | 6 | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 40 | 1 |
| **10** | 1 | 5 | 0 | 1 | 0 | 0 | 2 | 0 | 4 | 4 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 |
| **11** | 1 | 4 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 9 | 2 | 1 | 2 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| **12** | 1 | 6 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 8 | 3 | 3 | 0 | 1 | 4 | 0 | 0 | 0 | 1 | 1 | 0 | 90 | 2 |
| **13** | 1 | 6 | 3 | 1 | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 25 | 0 |
| **14** | 1 | 10 | 0 | 1 | 0 | 0 | 3 | 0 | 2 | 4 | 1 | 1 | 2 | 0 | 2 | 2 | 1 | 13 | 2 | 6 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 180 | 2 |
| **15** | 1 | 4 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 420 | 0 |
| **16** | 0 | 4 | 1 | 0 | 0 | 0 | 2 | 0 | 4 | 1 | 0 | 1 | 2 | 1 | 1 | 1 | 1 | 4 | 0 | 1 | 0 | 2 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 2 |
| **17** | 1 | 2 | 0 | 1 | 0 | 0 | 3 | 0 | 4 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 6 | 2 | 5 | 0 | 1 | 2 | 0 | 0 | 1 | 2 | 1 | 0 | 1200 | 2 |
| **18** | 1 | 10 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 2 | 2 | 0 | 1 | 1 | 1 | 5 | 2 | 2 | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 25 | 3 |
| **19** | 1 | 9 | 0 | 1 | 0 | 1 | 3 | 0 | 1 | 4 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 16 | 1 | 5 | 1 | 1 | 4 | 0 | 1 | 0 | 0 | 0 | 1 | 30 | 0 |
| **20** | 1 | 5 | 0 | 1 | 0 | 1 | 1 | 0 | 3 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 10 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| **21** | 1 | 7 | 0 | 1 | 0 | 1 | 2 | 0 | 3 | 4 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 3 | 1 | 0 | 1 | 3 | 0 | 0 | 0 | 1 | 2 | 1 | 10 | 2 |
| **22** | 0 | 5 | 0 | 1 | 0 | 0 | 2 | 0 | 4 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 3 | 0 | 2 | 0 | 1 | 1 | 0 | 0 | 2 | 2 | 1 | 1 | 180 | 3 |
| **23** | 0 | 10 | 2 | 1 | 0 | 1 | 3 | 0 | 4 | 4 | 0 | 5 | 2 | 0 | 1 | 3 | 0 | 14 | 3 | 3 | 0 | 2 | 5 | 0 | 0 | 0 | 0 | 1 | 1 | 60 | 1 |
| **24** | 1 | 5 | 1 | 1 | 0 | 0 | 3 | 0 | 4 | 4 | 0 | 3 | 1 | 0 | 0 | 3 | 1 | 15 | 7 | 0 | 0 | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 0 |
| **25** | 1 | 5 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 6 | 2 | 4 | 1 | 2 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 90 | 2 |
| **26** | 1 | 2 | 0 | 1 | 0 | 0 | 3 | 0 | 1 | 4 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 15 | 1 | 10 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 30 | 2 |
| **27** | 1 | 11 | 0 | 1 | 0 | 1 | 3 | 0 | 1 | 4 | 0 | 6 | 2 | 1 | 1 | 2 | 2 | 13 | 2 | 6 | 6 | 2 | 5 | 0 | 0 | 0 | 2 | 1 | 0 | 60 | 1 |
| **28** | 1 | 9 | 0 | 1 | 0 | 0 | 3 | 0 | 1 | 4 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 10 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 60 | 1 |
| **29** | 1 | 9 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 2 | 1 | 2 | 1 | 0 | 1 | 2 | 1 | 4 | 1 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 30 | 4 |
| **30** | 1 | 7 | 1 | 1 | 0 | 0 | 1 | 1 | 3 | 4 | 0 | 2 | 3 | 0 | 1 | 2 | 0 | 7 | 4 | 5 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 30 | 6 |

| Sr. | Q18 | Q19 | Q20 | Q21 | Q22 | Outage durations(1=ACCEPTED) | | | | | | | | | | Q24 | Q25 | Q26 | Q27 | Q28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Damages of appliances | Damages during last 12 Months (Value) | Any Injuries | Type of Injuries (minor=1,major=2) | Food damages (value) | 30 seconds | 5 minutes | 15 minutes | 30 minutes | 1 hour | 2 hours | 4 hours | 8 hours | 12 hours | 24 hours | low Services (more than 9 =10) | Electricity bill<br>1=1-100<br>2=100-200<br>3=201-300<br>4=301-500<br>5=501-750<br>6=751-1000<br>7=1001-1500<br>8=1501-2000<br>9=2001-3000<br>10=3001-4000 | Monthly income<br>0=???<br>1=less than 3000<br>2=3000-6000<br>3=6000-9000<br>4=9000-12000<br>5=12000-15000<br>6=More than 15000 | Willingness | Acceptable amount (%) |
| **1** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 4 | 0 | 0 |
| **2** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 | 1 | 5 |
| **3** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 7 | 4 | 0 | 0 |
| **4** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 3 | 4 | 0 | 0 |
| **5** | 0 | 0 | 0 | 0 | 1000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 4 | 3 | 1 | 3 |
| **6** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 3 | 4 | 0 | 0 |
| **7** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 4 | 3 | 0 | 0 |
| **8** | 1 | 1000 | 0 | 0 | 2000 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 5 | 1 | 10 |
| **9** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 5 | 6 | 0 | 0 |
| **10** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 7 | 2 | 0 | 0 |
| **11** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 4 | 0 | 0 |
| **12** | 1 | 500 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 4 | 0 | 0 |
| **13** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 4 | 6 | 0 | 0 |
| **14** | 0 | 100 | 0 | 0 | 100 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 0 | 1 | 10 |
| **15** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 6 | 0 | 0 |
| **16** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 5 | 3 | 1 | 2 |
| **17** | 0 | 0 | 0 | 0 | 100 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 4 | 0 | 0 |
| **18** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 1 | 4 | 1 | 5 |
| **19** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 7 | 6 | 0 | 0 |
| **20** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 6 | 1 | 10 |
| **21** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 5 | 1 | 5 |
| **22** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 6 | 5 | 2 | 0 | 1 |
| **23** | 0 | 200 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 6 | 0 | 0 |
| **24** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 3 | 0 | 0 |
| **25** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 5 | 0 | 0 |
| **26** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 3 | 6 | 1 | 10 |
| **27** | 0 | 0 | 0 | 0 | 200 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 5 | 3 | 1 | 5 |
| **28** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 6 | 1 | 4 |
| **29** | 0 | 0 | 0 | 0 | 10 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 4 | 0 | 0 |
| **30** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 2 | 0 | 0 |

| Sr. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | No. of appliances | | | | | | | | | | | | | | | Q13 | Q14 | Q15 | Q16 | Q17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Saudi (Yes=1 No-0) | Family members | Over 60 years | available in house most of the time | Commercial business | Medical equipment | Type of AC (w=1,c=2, s=3) | non-electrical heater | Lighting type(F=1,G=2,H=3,I=4) | House type(A=1,C=2,P=3,V=4) | Insulators | Refrigerators | Freezers | Dishwashers | Electrical ovens | Washers | Dryer | Air conditioners | Electrical Heating | Water heater | Space heater | Vacuum cleaner | TV | Sauna | Swimming pool | Elevator | Time of electricity outages (No outage=0, day=1, night=2) | Time of electricity outages (No.outage=0, summer=1,winter=2) | Notification | Average duration for electricity outages (in minutes) | No. of outage during last 12 months |
| **31** | 1 | 5 | 1 | 1 | 0 | 0 | 1 | 0 | 4 | 4 | 0 | 2 | 1 | 0 | 1 | 1 | 1 | 12 | 2 | 6 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 15 | 2 |
| **32** | 1 | 5 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| **33** | 1 | 11 | 2 | 0 | 0 | 1 | 3 | 1 | 1 | 4 | 0 | 4 | 4 | 0 | 0 | 2 | 1 | 12 | 5 | 13 | 10 | 3 | 6 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 15 |
| **34** | 1 | 9 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 8 | 0 | 4 | 0 | 2 | 4 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 4 |
| **35** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 3 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 7 | 4 | 4 | 3 | 3 | 4 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 2 |
| **36** | 1 | 9 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 2 | 2 | 0 | 0 | 1 | 1 | 12 | 5 | 5 | 15 | 2 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 180 | 3 |
| **37** | 1 | 6 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 5 | 1 | 2 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 5 | 2 |
| **38** | 1 | 5 | 1 | 1 | 0 | 0 | 1 | 0 | 4 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 5 | 2 | 3 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 4 | 2 |
| **39** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 8 | 0 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| **40** | 1 | 6 | 0 | 1 | 0 | 0 | 1 | 1 | 4 | 4 | 1 | 2 | 1 | 0 | 1 | 1 | 1 | 10 | 2 | 4 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| **41** | 1 | 4 | 0 | 1 | 0 | 0 | 3 | 0 | 1 | 4 | 1 | 2 | 1 | 0 | 1 | 1 | 0 | 7 | 1 | 3 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 1 | 0 | 120 | 1 |
| **42** | 1 | 7 | 1 | 1 | 0 | 0 | 3 | 0 | 1 | 4 | 1 | 4 | 1 | 0 | 1 | 3 | 0 | 12 | 2 | 8 | 2 | 2 | 5 | 0 | 0 | 0 | 2 | 1 | 0 | 120 | 0 |
| **43** | 1 | 7 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 4 | 0 | 2 | 1 | 1 | 1 | 1 | 1 | 9 | 0 | 1 | 0 | 1 | 2 | 0 | 1 | 0 | 1 | 1 | 0 | 40 | 9 |
| **44** | 1 | 5 | 1 | 1 | 0 | 0 | 3 | 0 | 1 | 1 | 1 | 2 | 1 | 0 | 0 | 2 | 0 | 8 | 1 | 2 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 60 | 2 |
| **45** | 1 | 5 | 0 | 1 | 0 | 1 | 2 | 0 | 1 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 90 | 3 |
| **46** | 1 | 5 | 2 | 1 | 0 | 1 | 3 | 0 | 1 | 4 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 13 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 25 | 1 |
| **47** | 1 | 4 | 0 | 1 | 1 | 0 | 2 | 1 | 3 | 4 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 0 | 2 | 4 | 0 | 0 | 0 | 1 | 1 | 1 | 40 | 0 |
| **48** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 3 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 7 | 2 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 60 | 1 |
| **49** | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 5 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 15 | 0 |
| **50** | 1 | 4 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 6 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 3 |
| **51** | 1 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 11 | 1 | 5 | 0 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 60 | 0 |
| **52** | 1 | 4 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 5 | 0 | 2 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 50 | 3 |
| **53** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 2 | 1 | 0 | 0 | 1 | 1 | 15 | 3 | 7 | 2 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| **54** | 1 | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| **55** | 1 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 9 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 2 |
| **56** | 1 | 9 | 0 | 1 | 0 | 0 | 1 | 0 | 4 | 4 | 0 | 4 | 1 | 0 | 0 | 2 | 2 | 13 | 4 | 5 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 1 | 1 | 30 | 3 |
| **57** | 1 | 3 | 0 | 1 | 0 | 0 | 3 | 0 | 3 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 2 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 120 | 1 |
| **58** | 1 | 10 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 7 | 0 | 4 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 |
| **59** | 1 | 3 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 2 | 4 | 1 | 0 | 2 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 120 | 2 |
| **60** | 1 | 4 | 0 | 1 | 0 | 1 | 1 | 0 | 3 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 6 | 1 | 2 | 0 | 1 | 3 | 1 | 0 | 0 | 0 | 1 | 0 | 30 | 3 |

| Sr. | Q18 | Q19 | Q20 | Q21 | Q22 | Outage durations(1=ACCEPTED) | | | | | | | | | | Q24 | Q25 | Q26 | Q27 | Q28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Damages of appliances | Damages during last 12 Months (Value) | Any Injuries | Type of Injuries (minor=1,major=2) | Food damages (value) | 30 seconds | 5 minutes | 15 minutes | 30 minutes | 1 hour | 2 hours | 4 hours | 8 hours | 12 hours | 24 hours | low Services (more than 9 =10) | Electricity bill 1=1-100 2=100-200 3=201-300 4=301-500 5=501-750 6=751-1000 7=1001-1500 8=1501-2000 9=2001-3000 10=3001-4000 | Monthly income 0=??? 1=less than 3000 2=3000-6000 3=6000-9000 4=9000-12000 5=12000-15000 6=More than 15000 | Willingness | Acceptable amount (%) |
| **31** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 6 | 4 | 0 | 0 |
| **32** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| **33** | 1 | 2500 | 0 | 0 | 4000 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 8 | 5 | 3 | 0 | 0 |
| **34** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 3 | 1 | 0 |
| **35** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 6 | 0 | 0 |
| **36** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 6 | 5 | 0 | 1 |
| **37** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 3 | 6 | 0 | 0 |
| **38** | 1 | 800 | 0 | 0 | 200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 5 | 0 | 0 |
| **39** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 4 | 0 | 0 |
| **40** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 5 | 4 | 1 | 1 |
| **41** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 4 | 2 | 0 | 0 |
| **42** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 7 | 4 | 0 | 0 |
| **43** | 1 | 8000 | 1 | 1 | 4500 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 4 | 2 | 1 | 3 |
| **44** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 4 | 7 | 3 | 0 | 0 |
| **45** | 1 | 43000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 7 | 6 | 0 | 0 |
| **46** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 5 | 0 | 0 |
| **47** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 7 | 6 | 0 | 0 |
| **48** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 2 | 4 | 0 | 0 |
| **49** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 1 | 6 | 1 | 10 |
| **50** | 0 | 0 | 0 | 0 | 100 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 5 | 0 | 0 |
| **51** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 4 | 1 | 10 |
| **52** | 1 | 250 | 0 | 0 | 50 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 3 | 6 | 0 | 0 |
| **53** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 5 | 4 | 0 | 0 |
| **54** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 6 | 3 | 0 | 0 |
| **55** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 1 | 3 | 0 | 0 |
| **56** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 5 | 4 | 0 | 0 |
| **57** | 1 | 200 | 0 | 0 | 200 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 4 | 2 | 0 | 0 |
| **58** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 6 | 3 | 0 | 0 |
| **59** | 0 | 0 | 1 | 1 | 200 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 4 | 0 | 0 |
| **60** | 1 | 200 | 0 | 0 | 100 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 0 | 0 |

| Sr. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | No. of appliances | | | | | | | | | | | | | | | Q13 | Q14 | Q15 | Q16 | Q17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Saudi (Yes=1 No-0) | Family members | Over 60 years | available in house most of the time | Commercial business | Medical equipment | Type of AC (w=1,c=2, s=3) | non-electrical heater | Lighting type(F=1,G=2,H=3,I=4) | House type(A=1,C=2,P=3,V=4) | Insulators | Refrigerators | Freezers | Dishwashers | Electrical ovens | Washers | Dryer | Air conditioners | Electrical Heating | Water heater | Space heater | Vacuum cleaner | TV | Sauna | Swimming pool | Elevator | Time of electricity outages (No outage=0, day=1, night=2) | Time of electricity outages (No.outage=0, summer=1,winter=2) | Notification | Average duration for electricity outages (in minutes) | No. of outage during last 12 months |
| **61** | 1 | 8 | 0 | 1 | 0 | 0 | 3 | 0 | 3 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 50 | 1 |
| **62** | 1 | 6 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 30 | 2 |
| **63** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 8 | 1 | 1 | 0 | 2 | 3 | 0 | 0 | 0 | 1 | 2 | 1 | 60 | 1 |
| **64** | 1 | 16 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 1 | 1 | 0 | 1 | 2 | 1 | 10 | 2 | 1 | 2 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 2 |
| **65** | 1 | 4 | 0 | 1 | 0 | 0 | 2 | 0 | 4 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 15 | 1 |
| **66** | 1 | 4 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 5 | 5 | 3 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 10 | 0 |
| **67** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 0 | 3 | 4 | 0 | 2 | 2 | 0 | 0 | 2 | 2 | 10 | 3 | 7 | 0 | 3 | 7 | 0 | 0 | 0 | 1 | 1 | 0 | 540 | 10 |
| **68** | 1 | 3 | 0 | 1 | 0 | 0 | 3 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 4 | 1 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 1 | 0 | 30 | 2 |
| **69** | 1 | 2 | 0 | 1 | 0 | 0 | 3 | 0 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 0 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 50 | 2 |
| **70** | 1 | 4 | 0 | 1 | 0 | 0 | 1 | 0 | 3 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 40 | 3 |
| **71** | 1 | 5 | 0 | 1 | 0 | 0 | 3 | 0 | 4 | 4 | 0 | 3 | 1 | 0 | 2 | 2 | 1 | 18 | 18 | 3 | 5 | 3 | 5 | 1 | 0 | 0 | 0 | 0 | 1 | 90 | 1 |
| **72** | 1 | 7 | 0 | 1 | 0 | 0 | 3 | 0 | 4 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 4 | 0 | 3 | 2 | 1 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 180 | 3 |
| **73** | 1 | 4 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 5 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 1 | 0 | 2 | 8 |
| **74** | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 1 |
| **75** | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 2 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 10 | 1 |
| **76** | 1 | 10 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 2 | 1 | 0 | 1 | 1 | 1 | 2 | 0 | 3 | 4 | 1 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 10 | 1 |
| **77** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 4 | 4 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 8 | 1 | 4 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 30 | 0 |
| **78** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 3 | 4 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 9 | 1 | 5 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 60 | 1 |
| **79** | 1 | 7 | 0 | 1 | 0 | 0 | 1 | 1 | 4 | 4 | 0 | 2 | 1 | 0 | 1 | 1 | 0 | 11 | 0 | 7 | 4 | 2 | 5 | 0 | 0 | 0 | 1 | 1 | 0 | 1440 | 4 |
| **80** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 10 | 1 | 1 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 1 |
| **81** | 1 | 4 | 0 | 1 | 0 | 0 | 3 | 0 | 3 | 4 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 6 | 1 | 8 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 120 | 1 |
| **82** | 1 | 5 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 7 | 2 | 3 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| **83** | 1 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 3 | 1 | 0 | 2 | 0 | 0 | 2 | 1 | 1 | 6 | 0 | 4 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 10 | 1 |
| **84** | 1 | 8 | 0 | 1 | 1 | 0 | 3 | 0 | 1 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 12 | 4 | 2 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 150 | 2 |
| **85** | 1 | 10 | 3 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 7 | 0 | 4 | 4 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 50 | 1 |
| **86** | 1 | 5 | 2 | 1 | 0 | 1 | 1 | 0 | 1 | 4 | 0 | 2 | 3 | 0 | 2 | 2 | 1 | 18 | 6 | 7 | 0 | 2 | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 50 | 3 |
| **87** | 1 | 2 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 1 | 1 | 180 | 2 |
| **88** | 1 | 7 | 0 | 1 | 0 | 0 | 3 | 0 | 2 | 4 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 10 | 4 | 1 | 4 | 1 | 2 | 0 | 0 | 0 | 2 | 1 | 1 | 60 | 3 |
| **89** | 1 | 3 | 2 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 0 | 8 | 2 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 240 | 0 |
| **90** | 1 | 4 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 3 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 150 | 5 |

| Sr. | Q18 | Q19 | Q20 | Q21 | Q22 | Outage durations(1=ACCEPTED) | | | | | | | | | | Q24 | Q25 | Q26 | Q27 | Q28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Damages of appliances | Damages during last 12 Months (Value) | Any Injuries | Type of Injuries (minor=1,major=2) | Food damages (value) | 30 seconds | 5 minutes | 15 minutes | 30 minutes | 1 hour | 2 hours | 4 hours | 8 hours | 12 hours | 24 hours | low Services (more than 9 =10) | Electricity bill 1=1-100 2=100-200 3=201-300 4=301-500 5=501-750 6=751-1000 7=1001-1500 8=1501-2000 9=2001-3000 10=3001-4000 | Monthly income 0=??? 1=less than 3000 2=3000-6000 3=6000-9000 4=9000-12000 5=12000-15000 6=More than 15000 | Willingness | Acceptable amount (%) |
| **61** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 3 | 6 | 6 | 0 | 0 |
| **62** | 0 | 100 | 0 | 0 | 100 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0.5 | 5 | 5 | 1 | 5 |
| **63** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 4 | 0 | 0 |
| **64** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 4 | 0 | 0 |
| **65** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 6 | 6 | 0 | 0 |
| **66** | 0 | 100 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 2 | 5 | 0 | 1 |
| **67** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 4 | 4 | 1 | 9 |
| **68** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 4 | 0 | 0 |
| **69** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 1 | 2 | 0 | 0 |
| **70** | 1 | 150 | 0 | 0 | 50 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 5 | 3 | 0 | 0 |
| **71** | 0 | 0 | 0 | 0 | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 8 | 6 | 0 | 0 |
| **72** | 1 | 2000 | 1 | 1 | 1000 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 4 | 2 | 0 | 0 |
| **73** | 1 | 2000 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 4 | 0 | 0 |
| **74** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0.5 | 1 | 1 | 0 | 0 |
| **75** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 3 | 2 | 0 | 0 |
| **76** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 9 | 6 | 0 | 0 |
| **77** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 4 | 0 | 0 |
| **78** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 2 | 4 | 0 | 0 |
| **79** | 1 | 2000 | 0 | 0 | 300 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 4 | 0 | 0 |
| **80** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0.5 | 3 | 4 | 0 | 0 |
| **81** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 0 | 0 | 24 |
| **82** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0.5 | 1 | 2 | 0 | 10 |
| **83** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 3 | 0 | 0 |
| **84** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 6 | 0 | 0 |
| **85** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 3 | 6 | 0 | 0 |
| **86** | 0 | 0 | 0 | 0 | 200 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 5 | 6 | 1 | 3 |
| **87** | 0 | 0 | 0 | 0 | 60 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 6 | 3 | 0 | 0 |
| **88** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0.5 | 6 | 6 | 0 | 0 |
| **89** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 3 | 0 | 0 |
| **90** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 2 | 0 | 1 |

| Sr. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | No. of appliances | | | | | | | | | | | | | | Q13 | Q14 | Q15 | Q16 | Q17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Saudi (Yes=1 No-0) | Family members | Over 60 years | available in house most of the time | Commercial business | Medical equipment | Type of AC (w=1,c=2, s=3) | non-electrical heater | Lighting type(F=1,G=2,H=3,I=4) | House type(A=1,C=2,P=3,V=4) | Insulators | Refrigerators | Freezers | Dishwashers | Electrical ovens | Washers | Dryer | Air conditioners | Electrical Heating | Water heater | Space heater | Vacuum cleaner | TV | Sauna | Swimming pool | Elevator | Time of electricity outages (No outage=0, day=1, night=2) | Time of electricity outages (No.outage=0, summer=1,winter=2) | Notification | Average duration for electricity outages (in minutes) | No. of outage during last 12 months |
| **91** | 1 | 10 | 0 | 1 | 0 | 0 | 2 | 1 | 3 | 4 | 1 | 1 | 0 | 1 | 2 | 2 | 2 | 4 | 2 | 2 | 1 | 3 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 40 | 1 |
| **92** | 1 | 5 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 2 | 0 | 1 | 0 | 1 | 5 | 0 | 0 | 0 | 0 | 0 | 1 | 25 | 0 |
| **93** | 1 | 5 | 0 | 1 | 0 | 1 | 2 | 1 | 3 | 4 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 5 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 2 |
| **94** | 1 | 6 | 0 | 1 | 0 | 1 | 2 | 0 | 1 | 4 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 2 | 0 | 2 | 2 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 1 |
| **95** | 1 | 7 | 0 | 1 | 0 | 0 | 2 | 0 | 4 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 |
| **96** | 1 | 9 | 0 | 1 | 0 | 0 | 2 | 0 | 3 | 4 | 1 | 2 | 3 | 0 | 1 | 2 | 1 | 10 | 5 | 8 | 2 | 2 | 4 | 0 | 0 | 0 | 2 | 1 | 0 | 60 | 2 |
| **97** | 1 | 12 | 2 | 1 | 0 | 0 | 3 | 0 | 1 | 4 | 1 | 2 | 2 | 0 | 2 | 2 | 1 | 24 | 7 | 8 | 0 | 2 | 7 | 0 | 0 | 0 | 0 | 0 | 1 | 40 | 1 |
| **98** | 1 | 11 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 30 | 9 |
| **99** | 1 | 7 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 4 | 0 | 2 | 2 | 0 | 0 | 1 | 1 | 10 | 1 | 5 | 2 | 1 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 10 | 1 |
| **100** | 1 | 8 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 8 | 2 | 2 | 1 | 1 | 3 | 0 | 0 | 0 | 2 | 1 | 0 | 60 | 3 |
| **101** | 1 | 12 | 1 | 1 | 0 | 1 | 3 | 0 | 1 | 4 | 1 | 4 | 2 | 2 | 1 | 3 | 2 | 20 | 0 | 3 | 1 | 3 | 5 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 |
| **102** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 2 | 0 | 0 | 1 | 0 | 10 | 0 | 2 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| **103** | 1 | 3 | 0 | 1 | 0 | 0 | 3 | 0 | 3 | 4 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 6 | 0 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 1 |
| **104** | 1 | 4 | 1 | 0 | 0 | 1 | 2 | 0 | 4 | 4 | 1 | 3 | 1 | 0 | 1 | 2 | 2 | 2 | 2 | 3 | 1 | 3 | 6 | 0 | 0 | 1 | 0 | 1 | 0 | 210 | 1 |
| **105** | 1 | 16 | 0 | 1 | 0 | 1 | 2 | 0 | 4 | 4 | 1 | 4 | 1 | 0 | 2 | 4 | 1 | 1 | 0 | 1 | 0 | 2 | 6 | 0 | 0 | 0 | 1 | 1 | 0 | 300 | 1 |
| **106** | 1 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 9 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 2 | 1 | 0 | 120 | 3 |
| **107** | 1 | 10 | 2 | 1 | 1 | 0 | 1 | 1 | 1 | 4 | 0 | 2 | 2 | 0 | 2 | 2 | 2 | 15 | 5 | 5 | 3 | 3 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 15 | 5 |
| **108** | 1 | 7 | 2 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 6 | 2 | 4 | 0 | 0 | 0 | 1 | 1 | 1 | 50 | 2 |
| **109** | 1 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 5 | 0 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 5 |
| **110** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 6 | 0 | 1 | 0 | 2 | 4 | 0 | 0 | 0 | 1 | 1 | 0 | 180 | 10 |
| **111** | 1 | 7 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 5 | 0 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 10 | 2 |
| **112** | 1 | 7 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 4 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 10 | 5 | 1 | 0 | 2 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 3 |
| **113** | 1 | 10 | 3 | 1 | 0 | 1 | 2 | 0 | 3 | 4 | 1 | 3 | 2 | 0 | 2 | 2 | 1 | 25 | 25 | 6 | 3 | 2 | 6 | 0 | 0 | 1 | 1 | 1 | 0 | 90 | 2 |
| **114** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 8 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 2 | 2 |
| **115** | 1 | 4 | 0 | 1 | 0 | 0 | 3 | 0 | 1 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 8 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 2 | 0 | 60 | 2 |
| **116** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 10 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| **117** | 1 | 9 | 1 | 1 | 0 | 0 | 1 | 0 | 3 | 4 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 11 | 2 | 4 | 0 | 1 | 4 | 0 | 0 | 0 | 1 | 1 | 0 | 300 | 2 |
| **118** | 1 | 2 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 7 | 2 | 3 | 2 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 90 | 2 |
| **119** | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 1 | 0 | 60 | 1 |
| **120** | 1 | 11 | 1 | 1 | 0 | 1 | 2 | 0 | 1 | 4 | 1 | 2 | 3 | 0 | 0 | 1 | 1 | 5 | 5 | 4 | 5 | 2 | 6 | 0 | 1 | 0 | 1 | 1 | 1 | 6 | 1 |

| Sr. | Q18 | Q19 | Q20 | Q21 | Q22 | Outage durations(1=ACCEPTED) | | | | | | | | | | Q24 | Q25 | Q26 | Q27 | Q28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Damages of appliances | Damages during last 12 Months (Value) | Any Injuries | Type of Injuries (minor=1,major=2) | Food damages (value) | 30 seconds | 5 minutes | 15 minutes | 30 minutes | 1 hour | 2 hours | 4 hours | 8 hours | 12 hours | 24 hours | low Services (more than 9 =10) | Electricity bill<br>1=1-100<br>2=100-200<br>3=201-300<br>4=301-500<br>5=501-750<br>6=751-1000<br>7=1001-1500<br>8=1501-2000<br>9=2001-3000<br>10=3001-4000 | Monthly income<br>0=???<br>1=less than 3000<br>2=3000-6000<br>3=6000-9000<br>4=9000-12000<br>5=12000-15000<br>6=More than 15000 | Willingness | Acceptable amount (%) |
| **91** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 7 | 3 | 0 | 0 |
| **92** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 7 | 6 | 0 | 0 |
| **93** | 0 | 0 | 0 | 0 | 1500 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 5 | 0 | 0 |
| **94** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 3 | 1 | 10 |
| **95** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 6 | 6 | 0 | 1 |
| **96** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 5 | 6 | 1 | 10 |
| **97** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 9 | 6 | 0 | 0 |
| **98** | 1 | 3500 | 1 | 1 | 2000 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 3 | 1 | 0 | 0 |
| **99** | 1 | 800 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 5 | 4 | 0 | 0 |
| **100** | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 2 | 0 | 0 |
| **101** | 1 | 2000 | 1 | 2 | 500 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 7 | 5 | 0 | 0 |
| **102** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 2 | 0 | 0 |
| **103** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 4 | 0 | 0 |
| **104** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 10 | 4 | 0 | 0 |
| **105** | 0 | 0 | 0 | 0 | 1000 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 9 | 6 | 1 | 5 |
| **106** | 1 | 2000 | 1 | 1 | 1500 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0.5 | 5 | 3 | 0 | 0 |
| **107** | 0 | 0 | 0 | 0 | 500 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 4 | 0 | 0 |
| **108** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 5 | 3 | 0 | 0 |
| **109** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 4 | 1 | 5 | 1 | 10 |
| **110** | 1 | 1000 | 0 | 0 | 200 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 3 | 5 | 0 | 0 |
| **111** | 1 | 2000 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 9 | 4 | 4 | 0 | 0 |
| **112** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 4 | 3 | 6 | 0 | 0 |
| **113** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 9 | 6 | 0 | 0 |
| **114** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 3 | 0 | 0 |
| **115** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 4 | 0 | 1 |
| **116** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 3 | 4 | 1 | 10 |
| **117** | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 4 | 3 | 0 | 0 |
| **118** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 4 | 0 | 0 |
| **119** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 0 | 1 |
| **120** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 6 | 6 | 0 | 0 |

| Sr. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | No. of appliances | | | | | | | | | | | | | | | Q13 | Q14 | Q15 | Q16 | Q17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Saudi (Yes=1 No-0) | Family members | Over 60 years | available in house most of the time | Commercial business | Medical equipment | Type of AC (w=1,c=2, s=3) | non-electrical heater | Lighting type(F=1,G=2,H=3,I=4) | House type(A=1,C=2,P=3,V=4) | Insulators | Refrigerators | Freezers | Dishwashers | Electrical ovens | Washers | Dryer | Air conditioners | Electrical Heating | Water heater | Space heater | Vacuum cleaner | TV | Sauna | Swimming pool | Elevator | Time of electricity outages (No outage=0, day=1, night=2) | Time of electricity outages (No.outage=0, summer=1,winter=2) | Notification | Average duration for electricity outages (in minutes) | No. of outage during last 12 months |
| **121** | 1 | 2 | 0 | 1 | 0 | 1 | 2 | 0 | 3 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 2 |
| **122** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 8 | 0 | 0 | 0 | 2 | 2 | 0 | 3 | 0 | 1 | 1 | 0 | 60 | 2 |
| **123** | 1 | 4 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 3 | 0 | 3 | 0 | 2 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 90 | 2 |
| **124** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 3 | 4 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 11 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 15 | 3 |
| **125** | 1 | 4 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 6 | 1 | 3 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 40 | 12 |
| **126** | 1 | 7 | 0 | 1 | 0 | 0 | 1 | 0 | 4 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 6 | 1 | 2 | 0 | 1 | 2 | 0 | 0 | 1 | 0 | 0 | 1 | 60 | 0 |
| **127** | 1 | 7 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 2 | 0 | 7 | 1 | 3 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 15 | 15 |
| **128** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 7 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 15 | 2 |
| **129** | 1 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 4 | 1 | 3 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 2 |
| **130** | 1 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 8 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 1 |
| **131** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 1 | 2 | 0 | 2 | 1 | 1 | 11 | 3 | 1 | 0 | 3 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 3 |
| **132** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 0 | 3 | 4 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 8 | 1 | 1 | 1 | 1 | 4 | 0 | 0 | 0 | 1 | 1 | 0 | 90 | 2 |
| **133** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 4 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 50 | 1 |
| **134** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 1 | 3 | 4 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 9 | 2 | 4 | 1 | 1 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 2 |
| **135** | 1 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 10 | 2 | 1 | 2 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 15 | 2 |
| **136** | 1 | 13 | 2 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 3 | 2 | 0 | 0 | 3 | 0 | 17 | 2 | 6 | 0 | 2 | 6 | 0 | 0 | 0 | 1 | 1 | 0 | 120 | 1 |
| **137** | 1 | 4 | 0 | 1 | 1 | 0 | 2 | 0 | 1 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 120 | 1 |
| **138** | 1 | 6 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 1 | 0 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 60 | 1 |
| **139** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 0 | 0 | 0 | 1 | 1 | 1 | 30 | 1 |
| **140** | 1 | 8 | 1 | 1 | 0 | 0 | 3 | 1 | 1 | 4 | 1 | 4 | 2 | 1 | 2 | 2 | 2 | 18 | 18 | 9 | 0 | 3 | 8 | 3 | 0 | 0 | 0 | 0 | 1 | 2 | 2 |
| **141** | 1 | 11 | 0 | 1 | 0 | 1 | 2 | 0 | 4 | 4 | 1 | 4 | 2 | 0 | 2 | 1 | 1 | 1 | 4 | 4 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 20 | 2 |
| **142** | 1 | 7 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 5 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 25 | 4 |
| **143** | 1 | 4 | 1 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 3 | 1 | 1 | 1 | 2 | 1 | 9 | 0 | 2 | 0 | 2 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 120 | 1 |
| **144** | 1 | 3 | 0 | 1 | 0 | 0 | 3 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 6 | 0 | 3 | 0 | 1 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 10 | 6 |
| **145** | 1 | 10 | 2 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 12 | 12 | 6 | 5 | 2 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 30 | 1 |
| **146** | 1 | 3 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 2 | 2 | 6 | 1 | 3 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 30 | 5 |
| **147** | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 10 | 3 |
| **148** | 1 | 6 | 0 | 1 | 0 | 0 | 3 | 0 | 1 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 10 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| **149** | 1 | 7 | 2 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 2 | 1 | 0 | 1 | 2 | 0 | 10 | 0 | 5 | 0 | 2 | 3 | 0 | 0 | 0 | 2 | 1 | 0 | 50 | 4 |
| **150** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 2 | 3 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 30 | 0 |

| Sr. | Q18 | Q19 | Q20 | Q21 | Q22 | Outage durations(1=ACCEPTED) | | | | | | | | | | Q24 | Q25 | Q26 | Q27 | Q28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Damages of appliances | Damages during last 12 Months (Value) | Any Injuries | Type of Injuries (minor=1,major=2) | Food damages (value) | 30 seconds | 5 minutes | 15 minutes | 30 minutes | 1 hour | 2 hours | 4 hours | 8 hours | 12 hours | 24 hours | low Services (more than 9 =10) | Electricity bill<br>1=1-100<br>2=100-200<br>3=201-300<br>4=301-500<br>5=501-750<br>6=751-1000<br>7=1001-1500<br>8=1501-2000<br>9=2001-3000<br>10=3001-4000 | Monthly income<br>0=???<br>1=less than 3000<br>2=3000-6000<br>3=6000-9000<br>4=9000-12000<br>5=12000-15000<br>6=More than 15000 | Willingness | Acceptable amount (%) |
| **121** | 1 | 500 | 0 | 0 | 200 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 2 | 4 | 0 | 0 |
| **122** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 3 | 1 | 2 |
| **123** | 0 | 5000 | 0 | 0 | 1000 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 3 | 2 | 1 | 3 |
| **124** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 4 | 0 | 0 |
| **125** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 2 | 4 | 1 | 10 |
| **126** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 4 | 3 | 0 | 0 |
| **127** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 5 | 3 | 0 | 0 |
| **128** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 6 | 0 | 0 |
| **129** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 4 | 0 | 0 |
| **130** | 0 | 0 | 0 | 0 | 250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 1 | 4 | 1 | 5 |
| **131** | 0 | 0 | 0 | 0 | 1000 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 4 | 0 | 0 |
| **132** | 0 | 1000 | 0 | 0 | 300 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 5 | 3 | 4 | 1 | 5 |
| **133** | 0 | 10 | 0 | 0 | 10 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 4 | 1 | 5 |
| **134** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 4 | 0 | 0 |
| **135** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 4 | 0 | 0 |
| **136** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 7 | 4 | 0 | 0 |
| **137** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0.5 | 3 | 4 | 0 | 0 |
| **138** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 6 | 6 | 0 | 0 |
| **139** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 4 | 0 | 0 |
| **140** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 4 | 4 | 1 | 5 |
| **141** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 4 | 0 | 0 |
| **142** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 3 | 5 | 0 | 0 |
| **143** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 6 | 6 | 0 | 0 |
| **144** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 6 | 0 | 0 |
| **145** | 1 | 500 | 0 | 0 | 800 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 8 | 6 | 0 | 0 |
| **146** | 0 | 0 | 0 | 0 | 50 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 2 | 0 | 0 |
| **147** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 1 | 3 | 0 | 0 |
| **148** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 4 | 6 | 0 | 0 |
| **149** | 1 | 1000 | 0 | 0 | 150 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 5 | 2 | 0 | 0 |
| **150** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 2 | 6 | 1 | 20 |

| Sr. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | No. of appliances | | | | | | | | | | | | | | | | Q13 | Q14 | Q15 | Q16 | Q17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Saudi (Yes=1 No-0) | Family members | Over 60 years | available in house most of the time | Commercial business | Medical equipment | Type of AC (w=1,c=2, s=3) | non-electrical heater | Lighting type(F=1,G=2,H=3,I=4) | House type(A=1,C=2,P=3,V=4) | Insulators | Refrigerators | Freezers | Dishwashers | Electrical ovens | Washers | Dryer | Air conditioners | Electrical Heating | Water heater | Space heater | Vacuum cleaner | TV | Sauna | Swimming pool | Elevator | Time of electricity outages (No outage=0, day=1, night=2) | Time of electricity outages (No.outage=0, summer=1,winter=2) | Notification | Average duration for electricity outages (in minutes) | No. of outage during last 12 months |
| **151** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 6 | 2 | 3 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 1 | 0 | 60 | 2 |
| **152** | 1 | 11 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 12 | 1 | 8 | 2 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 1 |
| **153** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 4 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 30 | 1 |
| **154** | 1 | 2 | 0 | 1 | 0 | 0 | 3 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 5 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 1 |
| **155** | 1 | 6 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 5 | 3 | 3 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 60 | 0 |
| **156** | 1 | 8 | 0 | 0 | 0 | 0 | 1 | 0 | 4 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 4 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 150 | 2 |
| **157** | 1 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| **158** | 1 | 8 | 1 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 6 | 1 | 1 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 60 | 1 |
| **159** | 1 | 9 | 0 | 1 | 0 | 0 | 3 | 0 | 1 | 4 | 1 | 2 | 1 | 0 | 1 | 1 | 1 | 8 | 2 | 3 | 0 | 1 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 90 | 4 |
| **160** | 1 | 6 | 0 | 1 | 0 | 0 | 3 | 0 | 1 | 4 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 9 | 2 | 2 | 0 | 2 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 25 | 1 |
| **161** | 1 | 7 | 0 | 1 | 0 | 0 | 3 | 0 | 4 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 13 | 7 | 3 | 0 | 2 | 2 | 0 | 1 | 0 | 0 | 0 | 1 | 180 | 0 |
| **162** | 1 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 5 | 0 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 20 | 2 |
| **163** | 1 | 6 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 4 | 0 | 0 | 0 | 1 | 2 | 0 | 10 | 1 |
| **164** | 1 | 6 | 0 | 1 | 0 | 0 | 2 | 0 | 4 | 4 | 1 | 2 | 2 | 0 | 1 | 1 | 1 | 3 | 0 | 1 | 0 | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| **165** | 1 | 15 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 4 | 2 | 1 | 0 | 2 | 2 | 10 | 2 | 2 | 4 | 3 | 4 | 0 | 0 | 0 | 1 | 1 | 0 | 20 | 13 |
| **166** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 4 | 0 | 3 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 30 | 6 |
| **167** | 1 | 6 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 4 | 1 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 420 | 1 |
| **168** | 1 | 5 | 0 | 1 | 0 | 1 | 3 | 1 | 3 | 4 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 7 | 0 | 5 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 8 | 0 |
| **169** | 1 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| **170** | 1 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 4 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 10 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 40 | 1 |
| **171** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 4 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 4 | 0 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| **172** | 1 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 6 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| **173** | 1 | 2 | 0 | 1 | 0 | 0 | 3 | 0 | 3 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 6 | 0 | 3 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| **174** | 1 | 5 | 0 | 1 | 0 | 0 | 2 | 0 | 3 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| **175** | 1 | 4 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| **176** | 1 | 5 | 2 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 2 | 1 | 0 | 1 | 1 | 1 | 11 | 4 | 4 | 3 | 3 | 3 | 0 | 0 | 0 | 1 | 1 | 1 | 150 | 3 |
| **177** | 1 | 8 | 0 | 1 | 0 | 0 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 2 | 0 | 1 | 3 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| **178** | 1 | 6 | 0 | 1 | 0 | 0 | 3 | 0 | 4 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 7 | 2 | 4 | 2 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 30 | 2 |
| **179** | 1 | 3 | 0 | 1 | 0 | 0 | 2 | 0 | 3 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 90 | 1 |
| **180** | 1 | 12 | 0 | 1 | 0 | 1 | 2 | 0 | 3 | 4 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 6 | 0 | 2 | 0 | 2 | 5 | 0 | 0 | 0 | 1 | 1 | 0 | 90 | 2 |

| Sr. | Q18 | Q19 | Q20 | Q21 | Q22 | Outage durations(1=ACCEPTED) | | | | | | | | | | Q24 | Q25 | Q26 | Q27 | Q28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Damages of appliances | Damages during last 12 Months (Value) | Any Injuries | Type of Injuries (minor=1,major=2) | Food damages (value) | 30 seconds | 5 minutes | 15 minutes | 30 minutes | 1 hour | 2 hours | 4 hours | 8 hours | 12 hours | 24 hours | low Services (more than 9 =10) | Electricity bill 1=1-100 2=100-200 3=201-300 4=301-500 5=501-750 6=751-1000 7=1001-1500 8=1501-2000 9=2001-3000 10=3001-4000 | Monthly income 0=??? 1=less than 3000 2=3000-6000 3=6000-9000 4=9000-12000 5=12000-15000 6=More than 15000 | Willingness | Acceptable amount (%) |
| **151** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 4 | 0 | 0 |
| **152** | 1 | 5000 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 4 | 2 | 0 | 1 |
| **153** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 4 | 0 | 0 |
| **154** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 6 | 0 | 0 |
| **155** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 2 | 5 | 0 | 0 |
| **156** | 0 | 0 | 0 | 0 | 100 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 3 | 1 | 5 |
| **157** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 1 | 2 | 0 | 1 |
| **158** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 5 | 4 | 0 | 0 |
| **159** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 4 | 0 | 0 |
| **160** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 5 | 0 | 0 |
| **161** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 7 | 6 | 1 | 10 |
| **162** | 0 | 200 | 0 | 0 | 200 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 1 | 5 |
| **163** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 5 | 6 | 0 | 0 |
| **164** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 6 | 0 | 0 | 0 |
| **165** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 9 | 2 | 0 | 0 |
| **166** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 1 | 4 | 1 | 0 |
| **167** | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 2 | 0 | 0 |
| **168** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 6 | 3 | 6 | 1 | 10 |
| **169** | 0 | 52 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 1 | 1 | 0 | 0 |
| **170** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 5 | 1 | 5 |
| **171** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 0 |
| **172** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 4 | 1 | 10 |
| **173** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0.5 | 3 | 4 | 0 | 0 |
| **174** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 3 | 3 | 1 | 5 |
| **175** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 2 | 1 | 0 | 0 |
| **176** | 0 | 0 | 0 | 0 | 1500 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 0 | 0 | 0 |
| **177** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 5 | 4 | 0 | 0 | 0 |
| **178** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 0 | 0 |
| **179** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 5 | 0 | 0 |
| **180** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 7 | 4 | 0 | 24 |

| Sr. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | No. of appliances | | | | | | | | | | | | | | | Q13 | Q14 | Q15 | Q16 | Q17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Saudi (Yes=1 No-0) | Family members | Over 60 years | available in house most of the time | Commercial business | Medical equipment | Type of AC (w=1,c=2, s=3) | non-electrical heater | Lighting type(F=1,G=2,H=3,I=4) | House type(A=1,C=2,P=3,V=4) | Insulators | Refrigerators | Freezers | Dishwashers | Electrical ovens | Washers | Dryer | Air conditioners | Electrical Heating | Water heater | Space heater | Vacuum cleaner | TV | Sauna | Swimming pool | Elevator | Time of electricity outages (No outage=0, day=1, night=2) | Time of electricity outages (No.outage=0, summer=1,winter=2) | Notification | Average duration for electricity outages (in minutes) | No. of outage during last 12 months |
| **181** | 1 | 4 | 0 | 1 | 0 | 1 | 1 | 0 | 4 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 5 | 4 | 4 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 150 | 3 |
| **182** | 1 | 4 | 0 | 1 | 0 | 0 | 2 | 0 | 4 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 3 | 0 | 4 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 15 | 2 |
| **183** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 8 | 2 | 2 | 2 | 2 | 3 | 0 | 0 | 0 | 1 | 2 | 0 | 20 | 1 |
| **184** | 1 | 8 | 0 | 1 | 0 | 0 | 2 | 0 | 3 | 4 | 1 | 5 | 2 | 1 | 2 | 1 | 1 | 6 | 6 | 1 | 5 | 1 | 8 | 1 | 1 | 0 | 1 | 1 | 0 | 60 | 3 |
| **185** | 1 | 7 | 0 | 1 | 0 | 0 | 3 | 1 | 2 | 4 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 12 | 4 | 8 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 2 | 1 | 60 | 2 |
| **186** | 1 | 4 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 2 | 1 | 0 | 60 | 0 |
| **187** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 2 | 0 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 40 | 1 |
| **188** | 1 | 6 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 10 | 1 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 50 | 8 |
| **189** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 6 | 0 | 4 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| **190** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | 0 | 5 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 15 | 2 |
| **191** | 1 | 4 | 0 | 1 | 0 | 0 | 3 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | 1 | 4 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 2 |
| **192** | 1 | 4 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 2 | 0 | 3 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 30 | 2 |
| **193** | 1 | 10 | 0 | 1 | 0 | 0 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 2 | 1 | 7 | 2 | 3 | 2 | 1 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 1 |
| **194** | 1 | 1 | 3 | 0 | 0 | 0 | 3 | 0 | 4 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 4 | 1 | 3 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 120 | 1 |
| **195** | 1 | 5 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 30 | 2 |
| **196** | 1 | 11 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 3 | 1 | 0 | 1 | 2 | 0 | 10 | 3 | 3 | 0 | 3 | 3 | 0 | 0 | 0 | 1 | 2 | 1 | 30 | 1 |
| **197** | 1 | 6 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 2 | 2 | 0 | 0 | 2 | 0 | 6 | 4 | 5 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 25 | 6 |
| **198** | 1 | 6 | 0 | 1 | 0 | 0 | 2 | 0 | 4 | 4 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 2 | 0 | 1 | 0 | 1 | 4 | 0 | 0 | 0 | 1 | 1 | 1 | 180 | 4 |
| **199** | 1 | 4 | 1 | 0 | 0 | 0 | 1 | 0 | 3 | 4 | 1 | 2 | 1 | 0 | 1 | 1 | 1 | 8 | 2 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 5 |
| **200** | 1 | 6 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 6 | 0 | 2 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 15 | 0 |
| **201** | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 4 | 2 | 2 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 1 |
| **202** | 1 | 3 | 0 | 1 | 1 | 0 | 1 | 0 | 4 | 4 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 11 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 30 | 2 |
| **203** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 8 | 3 | 1 | 0 | 3 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 20 | 2 |
| **204** | 1 | 10 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 2 | 0 | 15 | 3 |
| **205** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 60 | 2 |
| **206** | 1 | 7 | 0 | 1 | 0 | 0 | 2 | 1 | 1 | 4 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 15 | 3 |
| **207** | 1 | 10 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 3 | 1 | 0 | 3 | 3 | 3 | 15 | 0 | 7 | 0 | 3 | 4 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 2 |
| **208** | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 4 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 240 | 2 |
| **209** | 1 | 15 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 4 | 1 | 4 | 2 | 0 | 0 | 3 | 3 | 18 | 0 | 6 | 0 | 3 | 7 | 0 | 0 | 0 | 1 | 1 | 0 | 120 | 2 |
| **210** | 1 | 8 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 2 | 1 | 0 | 0 | 1 | 0 | 14 | 3 | 6 | 0 | 1 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 70 | 4 |

| Sr. | Q18 | Q19 | Q20 | Q21 | Q22 | Outage durations(1=ACCEPTED) | | | | | | | | | | Q24 | Q25 | Q26 | Q27 | Q28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Damages of appliances | Damages during last 12 Months (Value) | Any Injuries | Type of Injuries (minor=1,major=2) | Food damages (value) | 30 seconds | 5 minutes | 15 minutes | 30 minutes | 1 hour | 2 hours | 4 hours | 8 hours | 12 hours | 24 hours | low Services (more than 9 =10) | Electricity bill 1=1-100 2=100-200 3=201-300 4=301-500 5=501-750 6=751-1000 7=1001-1500 8=1501-2000 9=2001-3000 10=3001-4000 | Monthly income 0=??? 1=less than 3000 2=3000-6000 3=6000-9000 4=9000-12000 5=12000-15000 6=More than 15000 | Willingness | Acceptable amount (%) |
| **181** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0.5 | 4 | 6 | 1 | 100 |
| **182** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 2 | 5 | 0 | 1 |
| **183** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 6 | 1 | 7 |
| **184** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 7 | 5 | 1 | 100 |
| **185** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 6 | 0 | 0 |
| **186** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 4 | 0 | 0 |
| **187** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 4 | 0 | 0 |
| **188** | 1 | 5000 | 0 | 0 | 500 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 3 | 0 | 0 |
| **189** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 0 |
| **190** | 1 | 500 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 6 | 1 | 1 |
| **191** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 5 | 1 | 10 |
| **192** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 4 | 0 | 0 |
| **193** | 0 | 0 | 0 | 0 | 80 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 6 | 1 | 15 |
| **194** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 4 | 0 | 0 |
| **195** | 0 | 120 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 4 | 1 | 2 |
| **196** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 1 | 0 | 0 |
| **197** | 1 | 500 | 0 | 0 | 600 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 3 | 1 | 0 | 0 |
| **198** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 5 | 0 | 0 |
| **199** | 0 | 0 | 1 | 1 | 500 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 6 | 4 | 0 | 0 |
| **200** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 6 | 0 | 0 |
| **201** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 6 | 1 | 10 |
| **202** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 4 | 0 | 0 |
| **203** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 5 | 0 | 0 |
| **204** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 6 | 6 | 6 | 0 | 0 |
| **205** | 1 | 2600 | 0 | 0 | 500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 4 | 6 | 0 | 0 |
| **206** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 6 | 0 | 0 | 0 |
| **207** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 4 | 6 | 1 | 50 |
| **208** | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 6 | 0 | 0 |
| **209** | 0 | 0 | 0 | 0 | 1000 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 8 | 6 | 0 | 0 |
| **210** | 0 | 0 | 0 | 0 | 400 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 5 | 0 | 0 |

| Sr. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | No. of appliances | | | | | | | | | | | | | | | Q13 | Q14 | Q15 | Q16 | Q17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Saudi (Yes=1 No-0) | Family members | Over 60 years | available in house most of the time | Commercial business | Medical equipment | Type of AC (w=1,c=2, s=3) | non-electrical heater | Lighting type(F=1,G=2,H=3,I=4) | House type(A=1,C=2,P=3,V=4) | Insulators | Refrigerators | Freezers | Dishwashers | Electrical ovens | Washers | Dryer | Air conditioners | Electrical Heating | Water heater | Space heater | Vacuum cleaner | TV | Sauna | Swimming pool | Elevator | Time of electricity outages (No outage=0, day=1, night=2) | Time of electricity outages (No.outage=0, summer=1,winter=2) | Notification | Average duration for electricity outages (in minutes) | No. of outage during last 12 months |
| **211** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 4 | 2 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 120 | 3 |
| **212** | 1 | 12 | 3 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 1 | 4 | 0 | 2 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **213** | 1 | 9 | 0 | 1 | 0 | 0 | 1 | 0 | 2 | 4 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 240 | 4 |
| **214** | 1 | 7 | 0 | 1 | 0 | 1 | 1 | 1 | 4 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 120 | 8 |
| **215** | 1 | 6 | 0 | 1 | 0 | 1 | 1 | 0 | 4 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 180 | 2 |
| **216** | 1 | 7 | 1 | 1 | 0 | 1 | 1 | 0 | 4 | 4 | 0 | 2 | 1 | 0 | 0 | 2 | 1 | 8 | 0 | 3 | 0 | 1 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 1 |
| **217** | 1 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| **218** | 1 | 6 | 1 | 1 | 0 | 0 | 1 | 0 | 4 | 1 | 0 | 2 | 1 | 0 | 0 | 2 | 0 | 6 | 1 | 2 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 0 |
| **219** | 1 | 6 | 1 | 0 | 0 | 1 | 1 | 1 | 4 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 180 | 6 |
| **220** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 0 | 4 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 6 | 2 | 3 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 30 | 1 |
| **221** | 1 | 4 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 2 | 0 | 120 | 4 |
| **222** | 1 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 100 | 3 |
| **223** | 1 | 7 | 2 | 1 | 0 | 0 | 1 | 0 | 4 | 4 | 0 | 2 | 1 | 0 | 0 | 2 | 2 | 7 | 2 | 3 | 0 | 1 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 0 |
| **224** | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 6 | 2 | 2 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 120 | 0 |
| **225** | 1 | 4 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 1 | 1 | 0 | 0 | 2 | 1 | 8 | 2 | 0 | 0 | 1 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 30 | 2 |
| **226** | 1 | 4 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 2 | 1 | 0 | 1 | 2 | 0 | 3 | 1 | 2 | 0 | 1 | 3 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| **227** | 1 | 8 | 0 | 1 | 0 | 1 | 2 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 1 | 1 | 15 | 4 |
| **228** | 1 | 11 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 4 | 0 | 1 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 1 |
| **229** | 1 | 6 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 60 | 5 |
| **230** | 1 | 8 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 1 | 0 | 15 | 1 |
| **231** | 1 | 8 | 2 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 2 | 1 | 6 | 1 | 3 | 0 | 1 | 2 | 0 | 0 | 0 | 2 | 1 | 0 | 15 | 1 |
| **232** | 1 | 7 | 0 | 1 | 0 | 0 | 1 | 0 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| **233** | 1 | 13 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| **234** | 1 | 11 | 2 | 1 | 0 | 1 | 1 | 1 | 4 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 180 | 1 |
| **235** | 1 | 8 | 2 | 1 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 180 | 1 |
| **236** | 1 | 5 | 0 | 0 | 0 | 0 | 1 | 0 | 4 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| **237** | 1 | 10 | 2 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | 6 |
| **238** | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 4 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 4 | 0 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **239** | 1 | 7 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 0 | 1 | 0 | 0 | 2 | 1 | 0 | 5 | 0 | 3 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| **240** | 1 | 7 | 1 | 0 | 1 | 0 | 2 | 1 | 4 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 1 | 1 | 60 | 3 |

| Sr. | Q18 | Q19 | Q20 | Q21 | Q22 | Outage durations(1=ACCEPTED) | | | | | | | | | | Q24 | Q25 | Q26 | Q27 | Q28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Damages of appliances | Damages during last 12 Months (Value) | Any Injuries | Type of Injuries (minor=1,major=2) | Food damages (value) | 30 seconds | 5 minutes | 15 minutes | 30 minutes | 1 hour | 2 hours | 4 hours | 8 hours | 12 hours | 24 hours | low Services (more than 9 =10) | Electricity bill 1=1-100 2=100-200 3=201-300 4=301-500 5=501-750 6=751-1000 7=1001-1500 8=1501-2000 9=2001-3000 10=3001-4000 | Monthly income 0=??? 1=less than 3000 2=3000-6000 3=6000-9000 4=9000-12000 5=12000-15000 6=More than 15000 | Willingness | Acceptable amount (%) |
| **211** | 1 | 120 | 1 | 1 | 200 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 0 | 0 |
| **212** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 0 |
| **213** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 4 | 6 | 4 | 1 | 10 |
| **214** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0.5 | 2 | 1 | 0 | 0 |
| **215** | 0 | 1000 | 1 | 1 | 500 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0.5 | 7 | 3 | 0 | 0 |
| **216** | 1 | 400 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 3 | 0 | 0 |
| **217** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 0 |
| **218** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 3 | 0 | 0 |
| **219** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 2 | 1 | 0 | 0 |
| **220** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 2 | 0 | 0 |
| **221** | 1 | 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 3 | 0 | 0 |
| **222** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 2 | 1 | 0 | 0 |
| **223** | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 2 | 0 | 0 |
| **224** | 0 | 0 | 0 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 4 | 1 | 0 | 0 |
| **225** | 1 | 120 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 3 | 0 | 0 |
| **226** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 3 | 4 | 0 | 0 |
| **227** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 4 | 3 | 0 | 0 |
| **228** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 3 | 2 | 1 | 10 |
| **229** | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 3 | 2 | 0 | 0 |
| **230** | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 1 | 0 | 0 |
| **231** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 1 | 0 | 0 |
| **232** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 1 | 0 | 0 |
| **233** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 2 | 1 | 0 | 0 |
| **234** | 1 | 500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0.5 | 4 | 2 | 0 | 0 |
| **235** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 1 | 0 | 0 |
| **236** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 1 | 1 | 0 | 0 |
| **237** | 1 | 500 | 0 | 0 | 200 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 0 |
| **238** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 5 | 1 | 0 | 0 |
| **239** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 2 | 2 | 0 | 0 |
| **240** | 1 | 750 | 1 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 6 | 6 | 0 | 0 |

| Sr. | Survey No. | 241 | 242 |
|---|---|---|---|
| Q1 | Saudi (Yes=1 No-0) | 1 | 1 |
| Q2 | Family members | 5 | 7 |
| Q3 | Over 60 years | 0 | 2 |
| Q4 | available in house most of the time | 1 | 1 |
| Q5 | Commercial business | 0 | 0 |
| Q6 | Medical equipment | 0 | 0 |
| Q7 | Type of AC (w=1,c=2, s=3) | 1 | 1 |
| Q8 | non-electrical heater | 0 | 0 |
| Q9 | Lighting type(F=1,G=2,H=3,I=4) | 1 | 4 |
| Q10 | House type(A=1,C=2,P=3,V=4) | 1 | 4 |
| Q11 | Insulators | 0 | 0 |
| No. of appliances | Refrigerators | 1 | 2 |
| | Freezers | 1 | 1 |
| | Dishwashers | 0 | 0 |
| | Electrical ovens | 0 | 0 |
| | Washers | 1 | 2 |
| | Dryer | 0 | 2 |
| | Air conditioners | 6 | 7 |
| | Electrical Heating | 2 | 2 |
| | Water heater | 2 | 3 |
| | Space heater | 0 | 0 |
| | Vacuum cleaner | 1 | 1 |
| | TV | 2 | 3 |
| | Sauna | 0 | 0 |
| | Swimming pool | 0 | 0 |
| | Elevator | 0 | 0 |
| Q13 | Time of electricity outages (No outage=0, day=1, night=2) | 1 | 1 |
| Q14 | Time of electricity outages (No.outage=0, summer=1,winter=2) | 1 | 1 |
| Q15 | Notification | 0 | 0 |
| Q16 | Average duration for electricity outages (in minutes) | 120 | 60 |
| Q17 | No. of outage during last 12 months | 0 | 0 |

| Sr. | Q18 | Q19 | Q20 | Q21 | Q22 | Outage durations(1=ACCEPTED) | | | | | | | | | | Q24 | Q25 | Q26 | Q27 | Q28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey No. | Damages of appliances | Damages during last 12 Months (Value) | Any Injuries | Type of Injuries (minor=1,major=2) | Food damages (value) | 30 seconds | 5 minutes | 15 minutes | 30 minutes | 1 hour | 2 hours | 4 hours | 8 hours | 12 hours | 24 hours | low Services (more than 9 =10) | Electricity bill<br>1=1-100<br>2=100-200<br>3=201-300<br>4=301-500<br>5=501-750<br>6=751-1000<br>7=1001-1500<br>8=1501-2000<br>9=2001-3000<br>10=3001-4000 | Monthly income<br>0=???<br>1=less than 3000<br>2=3000-6000<br>3=6000-9000<br>4=9000-12000<br>5=12000-15000<br>6=More than 15000 | Willingness | Acceptable amount (%) |
| **241** | 0 | 0 | 0 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 4 | 1 | 0 | 0 |
| **242** | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 2 | 0 | 0 |

# Vita

**Name:** Talal Hasan Al-Malki

**Date of Birth:** 4th April 1980

**Nationality:** Saudi

**Email:** malki.talal@gmail.com

**Phone:** 00966 (0) 505807001

**EDUCATION:**

Bachelor Degree of Electrical Engineering from King Fahd University of Petroleum & Minerals (June 2003) , Dhahran, Saudi Arabia.

Master Degree of Science in Electrical Engineering from King Fahd University of Petroleum & Minerals (January 2011) , Dhahran, Saudi Arabia.

**EXPERIENCE:**

Aug 2003 - June 2004: Worked in system development and improvement division with Saudi Electricity Company (SEC) as electrical engineer.

July 2004 – March 2010: Start working with the Saudi Basic Industries Corporation SABIC under Procurement Organization as Senior Specialist Buyer.

Since April 2010: Leading Regional Indirect Material Procurement Section with SABIC.